ELECTRICAL REVIEW

May 18, 1945

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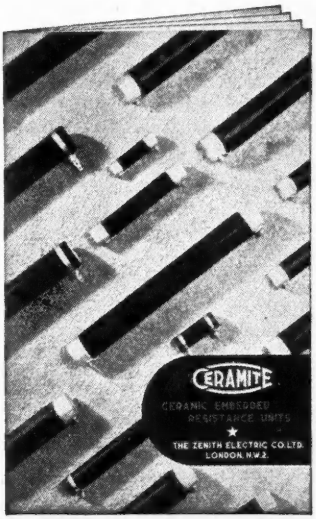

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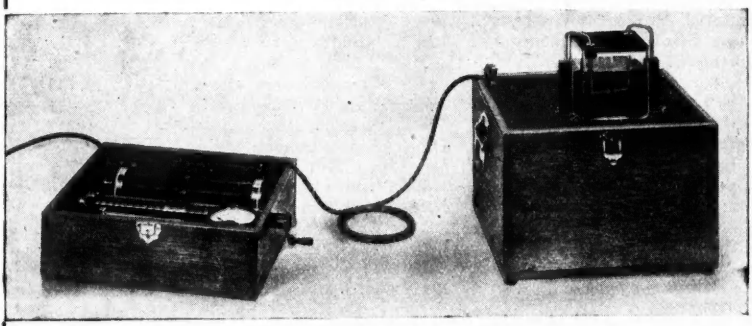

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

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Professional Interests

Institution's Service to Members

THE latest annual report of the Council of the Institution of Electrical Engineers covers a period of great national stress. It bears witness, however, to the confidence then felt, and now justified by the event, in an early successful outcome of the European section of the war, since in addition to furthering the war aims, it records manifold preparations to aid electrical engineers to take their full share of responsibility for reconstruction when world victory has been achieved.

Progressive increase in membership is the most conspicuous sign of virility of an organisation of this kind and the I.E.E. continues to grow. There is reason for pride in that it is numerically the largest of any scientific or technical body in the world, but even more in its holding of the premier position also in regard to the number of those who have passed the rigorous tests necessary to secure corporate membership, carrying with it the title of "chartered electrical engineer." Moreover, last year's increase in the latter case was attained despite the obstacles to preparing for examinations met by many engaged in the Forces or in other war work.

Expansion of Radio Section

The progress made in the special sections, especially in regard to the Local Centre groups, has demonstrated the need for them. This is particularly noticeable in the case of the Radio Section, as it is now known, which has annexed the potentially great field of electronics. Radio comes into prominence in another way and that is in the appointment of a committee to review the I.E.E. report of 1936 on interference with broadcasting in the light of subsequent happenings. One of these is presumably the recent Television Report, which recommended that interference suppression should be made enforceable by law—probably the only way in the present instance of achieving practical results. The preparation of regulations governing radio and other electrical equipment in civil aircraft provides another reference to future practice.

News and Reviews

Educational activities have been pursued with vigour with especial reference to those who have been handicapped by war service, whether military or civil. In a broader sense these have also related to Local Centres abroad, some of which have necessarily been in a state of suspended animation, and to their members the news letter service should prove a great boon. Of great educational value in another way have been the "reviews of progress" published from time to time in the *Journal*. For security reasons not many of these have appeared lately, but their resumption as soon as circumstances permit is hoped for by many.

A welcome and, some might consider, a somewhat belated accession to the I.E.E. organism is a permanent research committee. Its terms of reference were quoted in the abstract of the report given in our last issue. In view of the proposals of the Post-War Planning Committee for setting up a British Electrical Research Board, the work of the new Committee

may be expected to cover patents as well. It is to be inferred from the Council's report that strenuous as have been the past efforts of electrical engineers in the national interest there will be little relaxation of their duties in the future. But they would not have it otherwise.

The Emergency Pool

ONE VE-Day result is the dispersal of the national pool of switchgear and transformers. Although the hazard of air attack has been removed, it should be noted that of the nineteen issues from the pool up to the end of 1943, only twelve were on account of enemy action. On three occasions the date on which urgently needed new supplies could be given was advanced by its aid and for a somewhat similar purpose supply undertakings are now given an opportunity to purchase the equipment before it is sent abroad. The other four issues were made to effect temporary repairs after accidental fires. Although the locking up of useful plant now cannot be considered, the value of a central reserve should be borne in mind when conditions become more favourable.

Lighting Relief

ALTHOUGH in a note appended to the Lighting (Restrictions) (No. 2) Order, 1945 (S.R. & O. 1945 No. 472, Stationery Office, 1d.), it is stated that the purpose of Article 4 is to remove *all* restrictions on lights, it should be noted that shop-window lighting and neon advertisement signs are covered by the Control of Fuel (No. 3) Order, 1942. Article 5 of this Order prohibits the use of fuel for advertisement or display in the course of any business. The prohibition applies to display lighting in any form, but, to the public delight, there was a temporary relaxation of the rule last week to permit of the floodlighting of public buildings.

Continuance of Control

WITH the approach and actual advent of peace in Europe there has been much discussion of the subject of control. A few people have been bold enough to advocate the almost immediate abandonment of control, while at the other extreme there are those who desire not only continuance but more and more. Most people, however, adopt the sane view that orderly reversion to a normal way of life can only be made by a maintenance of the Government's hold upon national affairs, to be " tapered off " as rapidly as changing circumstances allow. The Supplies & Services (Transitional Powers) Bill which has just been introduced is designed to continue certain of the Defence Regulations and Orders made thereunder, the aim being to secure at fair prices sufficient essential supplies and services or their equitable distribution; to facilitate the readjustment of industry and commerce to peacetime requirements; and to assist the relief of war distress in the Dominions and foreign countries.

Electricity and Food

AT Érith, noted for its pre-war electric cooking campaigns, the association of electricity and food has been carried a stage further during the war, for Mr. E. A. Logan, the borough electrical engineer, is also borough catering manager—a voluntary appointment carrying no remuneration. A report on the operations of the Catering Department just issued, written in Mr. Logan's usual interesting style, gives an account of the evolution of the Department and the many problems encountered. It started in the early days of the air raids when a number of officials and councillors on duty at Electricity House discussed the matter over an evening meal improvised by themselves. Since then more than two and three quarter million meals have been served—almost a million in the latest year when the turnover amounted to £41,600. Electricity was not necessarily the medium for cooking, but it is recorded that the substations were found to be ideal places for emergency food storage.

Export Details

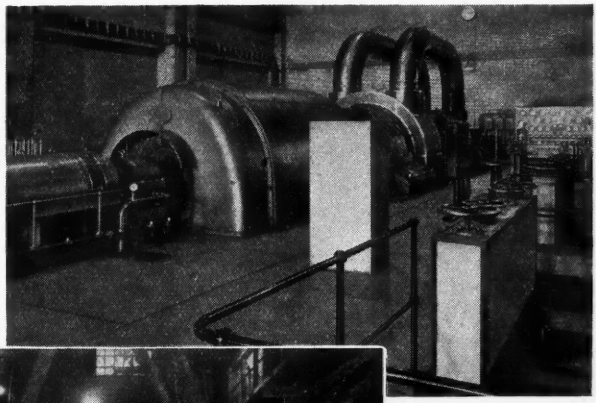
CONDITIONS in overseas markets are generally very different from those at home, a fact which exporters should never forget and good exporters never do. Then the overseas buyer is far from the source of supply and can seldom obtain immediate advice and assistance. This being so his troubles should be anticipated and met in advance by the exporter. In an article in this issue Mr. F. G. Copland mentions a few of the details of which suppliers should be aware, attention to which is a powerful builder of goodwill. Most of them are comparatively small matters which can be met at very little additional expense—an expense which it is worth while incurring.

Power Station Developments

Wartime Extensions at Newport

ONE of several interesting generating station extension schemes carried out during the war is that at Newport, Mon., which embraces a 30,000-kW Fraser Chalmers-G.E.C. turbo-alternator set and two 150,000-lb. per hour (m.c.r.) Babcock & Wilcox boilers, together with the necessary auxiliaries, and was put into commission in 1940. This extension has involved a change in the station steaming conditions, for while the conditions of the new boilers are 625 lb. per sq. in. and 875 deg. F., those of the older plant are 270 lb. per sq. in. and 650 deg. F.

Before the new plant was installed the station boiler capacity was 420,000 lb. per hr., made up of eight smaller boilers in varying sizes up to 80,000 lb. per hr., which served 28,750 kW of main turbo-alternator plant in four sets of sizes up to 10,000 kW each. To accommodate the new plant both the turbine room and the boiler house have been extended several feet in the same direction. The boilers are of the single-drum water-tube type and are complete with Babcock & Wilcox flash-welded economisers, Melesco superheaters, Bailey water-tube walls and International Combustion under-feed twin stokers. Each economiser is situated between the boiler and the air pre-heaters. There are two Howden-Ljungstrom vertical air preheaters per boiler, situated between the economiser outlet and the i.d. fans. Each preheater has a heating surface area of 6,000 sq. ft. The Bailey walls of each boiler have a total heat-collecting area of 1,060 sq. ft. The boiler proper heating surface area is 12,116 sq. ft., and the super-heater area is 7,400 sq. ft. The corresponding figure for the economiser is 11,700 sq. ft.

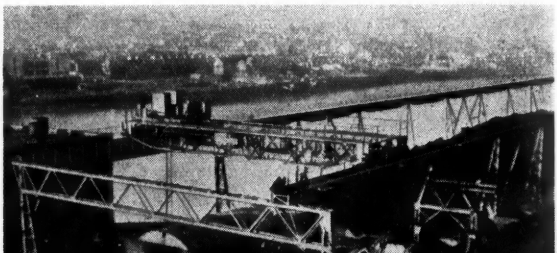


The extension embraces one 30,000-kW turbo-alternator set and two 150,000-lb. per hr. boilers

Copes automatic feed-water regulators, Aiton steam and feed piping with welded joints, except where valves are interposed, Hopkinsons valves, etc., and C. A. Parsons periscopic and "Igema" water-level indicators are among the usual boiler fittings, while "Beco" baffles direct the flue gases through boiler tubes. Howden "Multicell Vortex" grit arrestors are installed on the boiler-house roof and discharge to the i.d. fans, and for

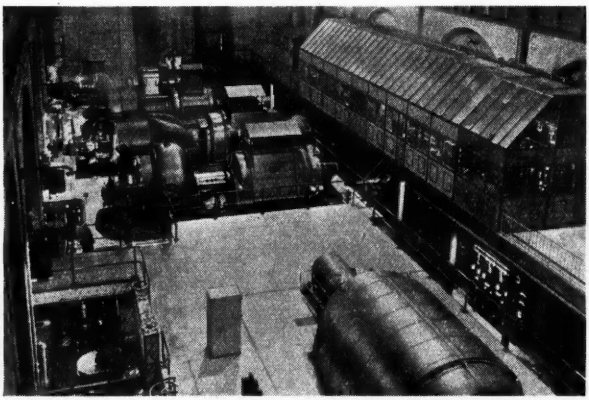
removing the grit from these arrestors and the boiler passes there is installed a British Vacuum Co. motor-driven vacuum plant. Each boiler is complete with its own "Gunite"-lined steel stack which, rising from the boiler-house roof, is 72 ft. high and 7 ft. in diameter.

The extension can be regarded almost as a self-contained station because the new plant is normally run independently of the old. Viewed in terms of "production lines," the combustion line of the installation starts with new Babcock & Wilcox coal-handling plant with which is associated a new storage ground for 12,000 tons of coal. This ground is served by an overhead travelling grabbing crane. It is adjacent to special railway sidings on which 20-ton wagons are received by a Babcock & Wilcox side-wagon tippler which discharges the coal into a hopper. From this is fed a 100-tons per hr. tray conveyor discharging to a 100-tons per hour gravity-bucket conveyor which serves the new boiler bunkers. It is also arranged for the tray conveyor to feed a 30-tons per hr. gravity-bucket conveyor which is part of the original coal-handling plant and serves the bunkers of the older boilers. The overhead travelling grabbing crane serves for both stocking and reclaiming, with grab delivery both from and to the hopper of the new handling plant.



Associated with the new coal-handling plant is a storage ground for 12,000 tons of coal, served by an overhead travelling grabbing crane, and a side wagon tippler

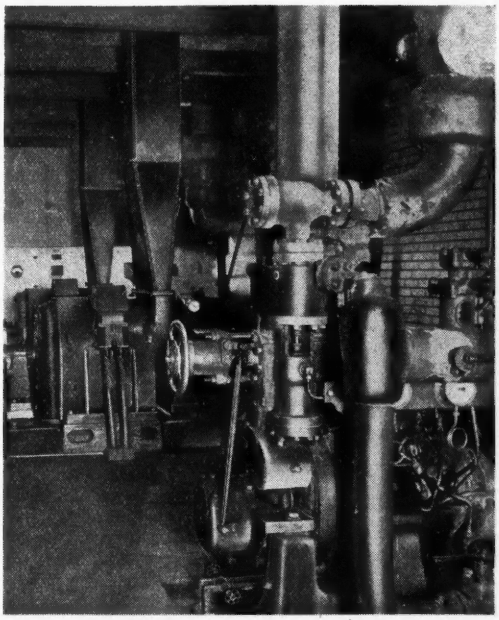
The coal is gravity fed from the bunkers to the boiler stokers in the normal way. The complete twin stoker grate area is 473 sq. ft. Each grate of the stoker has its own individual drive, but both of the stoker motors are served by a common motor-generator set for Ward - Leonard control by means of which the grate speeds are independently infinitely variable from zero to 60 ft. per min. The value of this scheme can be appreciated from the fact that it is not uncommon for two grates of one boiler to be fed simultaneously with coal of different



Before the installation of the new plant the station main plant capacity was 28,750 kW in four sets. The electrical end of the new set is in the foreground and the enclosed control board on right

characteristics. The ashes pass from the stokers to paddle-type quenching and removal equipment, and then to belt conveyors common to all the boilers, new and old.

The combustion gases of each boiler are handled by two i.d. and two secondary-air fans—all Howden. The f.d. and i.d. fans are on the boiler-house roof, and the secondary-air fans,

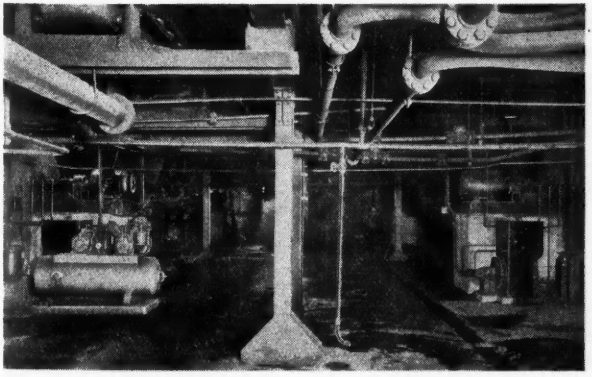


Two 300,000-lb. per hr. motor-driven feed-water pumps serve each boiler, and in addition there is (front right) a steam pump with automatic starting arrangements

which introduce air over the boiler front arch, are in the ash-plant basement.

The f.d., i.d. and secondary-air fans are of the silent-vane, single-inlet, vane-controlled type; turbo-vane, single-inlet, vane-controlled type; and single-inlet, damper-controlled type, respectively. The respective capacities of the fans at m.c.r. are 24,000, 35,700 and 8,350 cu. ft. per min. The outlet temperatures are 80, 260 and 265 deg. F., respectively. The f.d. and i.d. fans are driven by two-speed motors which are automatically controlled through contactor switchgear by the boiler-control system a description of which follows, while the secondary-air fans are driven by constant-speed motors.

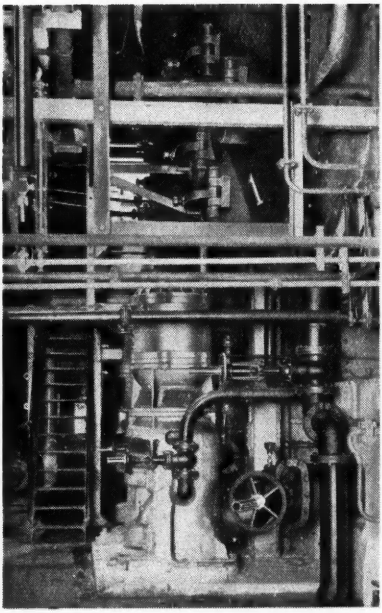
The boilers may be described as semi-automatically controlled, and the control of all the auxiliaries except the stokers is governed by the steam pressure. For the f.d. and i.d. fans the Bailey compressed-air system of automatic control is employed, and serving this system there is in the basement a motor-driven Ingersoll-Rand air compressor. On the boiler control board and desk, which in each case stands by the side of its boiler at the firing-floor level, is a master controller which is operated by rises and falls in the steam pressure. These master-controller oper-



The secondary-air fans (two per boiler) are in the ash basement; note air compressor on left for automatic boiler control system

ations allow or stop the passage to or from any of the Bailey cylinder and piston units on the roof, according to the direction of a master

selector and individual selectors for the f.d. and i.d. fans. In each case the movement of the piston opens or closes the fan vanes.



There are two condensate vertical extraction pumps

If a fan is running at its low speed and there is a further drop in the steam pressure after the piston has reached its " high " limit, the fan is automatically changed over to high speed and the vane controllers are immediately brought back to the required draught positions.

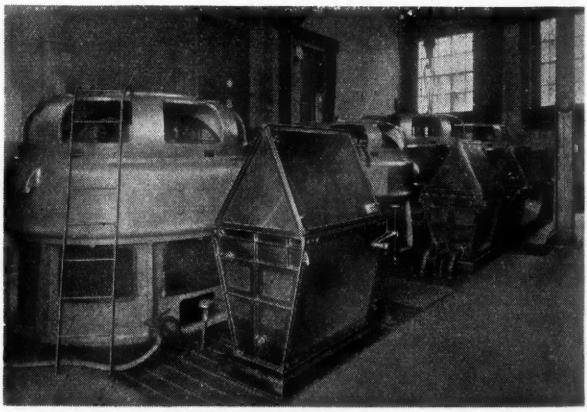
An earlier experiment led to the change-over of the station from cooling-tower to river-water and the success of the experiment is reflected in the present common circulating-water pumping house

The Lockheed system of operation is employed for the boiler dampers, but in this case the control is manual from the same central boiler control board. Automatic superheat control is effected by the " Superheater-Kent " system which provides a de-superheater between the primary and secondary sections of the boiler superheater. According to the steam conditions at the superheater exit, thermostatically controlled valves operate so that the steam either passes through or by-passes the de-superheater. The boiler stop valves and section valves on the main steam line are all motor operated and normally controlled from the boiler control board, but for emergency use there are push-buttons in the turbine room for operating the valve motors.

The boilers are equipped with Babcock electrically operated soot blowers which are automatically sequence controlled by the B.T.H. system for this purpose. The first of the 36 sets of blowers in the sequence arrangement are started up by push-button, and the subsequent sets are automatically put into operation, in turn, by automatic-telephone type relays.

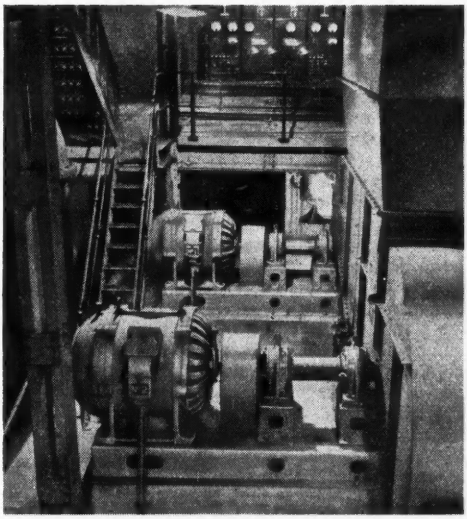
Two Mather & Platt motor-driven multi-stage feed-water pumps serve the boilers, and in addition a Weir steam turbine-driven pump is provided as a stand-by and has special arrangements for automatic starting-up in emergency. Each of these pumps, both steam and electric, has a capacity of 300,000 lb. of water per hr.

The one l.p. bleeding point serves one l.p. heater, which also receives the evaporate from the evaporator, and the three h.p. bleeding points serve the three h.p. heaters. The first h.p. bleeding point also supplies the evaporator. The feed-water circuit is



from the condensers, as condensate, *via* the extraction pumps and air ejector, to the gland heater which retrieves heat from the leak-off of the turbine glands, and then, in turn, to the l.p. heater, the drain cooler, the feed pump, the h.p. heaters and the economiser. At m.c.r. the final temperature of the feed water at the last h.p. heater is 340 deg. F. Vapour from the evaporators is passed to the l.p. heater and then to the condenser for de-aeration. The evaporators are fed with make-up from the town water mains. Each evaporator will supply 6,230 lb. of water per hour.

Drains from the drain cooler can be either pumped into the feed-water circuit or discharged to the condenser shell by an automatic trap. The make-up water from the surge tank is taken through an automatic condensate control valve which discharges it to the condenser shell for de-aeration before it is circulated into the feed suction line. The water from the condensate water control valve passes through the condenser make-up valve, the primary function of which is to prevent flooding as the result of receiving a surplus of make-up.



Forced-draught cooling is employed for the alternator ventilation by means of two fans which serve *via* a water-cooled air cooler

The turbo-alternator set runs at 3,000 RPM. The turbine, which has steam conditions of 600 lb. per sq. in. and 850 deg. F., is a two-cylinder machine with 22 stages in the h.p. cylinder and six stages in each section of the double-flow l.p. cylinder, *i.e.*, 28 expansion stages in all.

The turbine exhausts to Hick Hargreaves twin condensers, both of which are normally used, but the turbine can be run with one condenser only at reduced load. The condenser auxiliaries include two three-stage steam air ejectors and one booster ejector for starting-up purposes. Each ejector is capable of handling the full condenser output. There are also two motor-driven condensate extraction pumps. The circulating water is received from the pumping station common to the whole of the power-station plant, although a new 1·5 million gall. per hr. circulating pump is a part of the extension under survey. The total capacity of the pumping station is now 5 million gall. per hr. A new Brackets band screen of the same capacity as the pump was installed with the new pump.

Although the generating station is situated on one bank of the river Usk it was originally a cooling-tower station because of the bad river-water conditions through big tidal variations. In 1922 an experimental pumping house was established, consisting of two Lancashire boiler shells bolted together end-to-end and sunk into the river bank to a point below the lowest tide level. In this structure was installed a motor-driven centrifugal submerged pump. The experiment was so successful that the station was changed over from cooling-tower to river-water operation and the experiment is to-day reflected in the common pumping house for the whole station.

To all intents and purposes the new generating plant is run as a self-contained unit quite separately from the old plant, although the new and old plants are paralleled on the electrical side. So that the plant can be paralleled on the steam side under emergency conditions, there is a Hagan reducing valve and de-superheater in the connection between the new and old plants, and in this way the old turbine plant can be run from the new boilers.

The electrical side of the station calls for very little comment because the operation is normal and standard from all points of view.

The turbo-alternator is typical of several machines of similar rating and construction in satisfactory operation in this country. It has a continuous maximum rating of 30,000 kW over a power-factor range from 0·8 lagging to 0·9 leading. The alternator itself is arranged for closed-circuit cooling; two motor-driven external fans are fitted in the basement together with a Heenan & Froude water-cooled air cooler. The alternator slip-rings—one at each end of the machine—and the exciters have open-type ventilation to secure maximum accessibility. The directly coupled exciter unit consists of main and pilot exciters, the main exciter being fitted with a small counter current field to destroy the residual magnetism. The alternator has a reactance of 15 per cent. to keep down the instantaneous short-circuit fault currents. The main switchgear to which are connected the alternators, the C.E.B. transformers and the group feeders to the distribution switchgear, is a double bus-bar metal-clad board. The capacity of the circuit-breakers was originally 500 MVA at 6·2 kV, but this has now been increased to 750 MVA at 6·2 kV by fitting the breakers with arc control pots. A new 3,000-A unit of this capacity, together with a new bus-coupler unit, have been added to serve the new alternator. While this work was being carried out the opportunity was taken to sectionalise the board. In the general arrangement a bus-section unit and a bus-coupler unit were situated approximately at the centre of the board. By removing the bus-coupler unit to one end of the board and setting the bus-section unit in the middle of the space previously occupied by the two units together, sufficient room was obtained to build a fireproof wall on either side of the bus section unit. There is also a three-panel extension of the control board—one panel for the voltage-regulation equipment, one for the alternator and one for the exciter equipment.

We are indebted for permission to visit the station to Mr. T. H. Wood, M.I.Mech.E., A.M.I.E.E., borough electrical engineer and manager, and for help in collecting the information in this article to Mr. R. L. Axford, the chief technical assistant, and to Mr. J. Ellis, the station superintendent. In his former capacity as chief technical assistant to the late Mr. Nichols Moore, Mr. Wood played a leading part in the design of the extension described, and he is also responsible for a further extension embracing a 30,000-kW turbo-alternator and two 180,000-lb. per hr. boilers, which is now in the very earliest stages of construction.

Forthcoming Events

Saturday, May 19th.—*London.*—Beaver Hall, Garlick Hill, 2 p.m. Association of Scientific Workers. Twenty-eighth annual Council meeting. (Also Sunday and Monday.)

Tuesday, May 22nd.—*London.*—Institution of Electrical Engineers, 5.30 p.m. Radio Section. Discussion on "Non-Ferrous Contact Springs," to be opened by Dr. H. G. Taylor and Dr. L. B. Hunt.

Wednesday, May 23rd.—*London.*—Royal Society of Arts, Adelphi, 1.45 p.m. Thomas Howard Lecture: "Wire Broadcasting," by Paul Adorjan, A.M.I.E.E.

London.—At Institution of Mechanical Engineers, 6 p.m. Institution of Heating and Ventilating Engineers. "Heating by Electrode Boilers Without Thermal Storage," by J. Jamieson, B.Sc. (Eng.), A.M.I.E.E.

Thursday, May 24th.—*London.*—University College Anatomy Theatre (entrance from Gower Street), 1.15 p.m. Lunch-hour lecture on "Standardisation in Reconstruction," by Percy Good, C.B.E. (Director, British Standards Institution). Admission free without ticket.

London.—Institution of Electrical Engineers, 5.30 p.m. "High-Voltage Steel-Tank Mercury-Arc Rectifier Equipments for Radio Transmitters," by J. C. Read, M.Sc., and "The Application of High-Voltage Steel-Tank Mercury-Arc Rectifiers to Broadcast Transmitters," by P. A. T. Bevan, B.Sc.

Friday, May 25th.—*London.*—Room 62, Bethnal Green Town Hall, Cambridge Heath Road, 6.30 p.m. E.P.E.A. Southern Divisional Meter Engineers' Group. "Centralised Control," by R. C. Tuffnall.

Saturday, May 26th.—*Bristol.*—Victoria Rooms, 3 p.m. I.E.E. Bristol Students' Section. Annual general meeting and lecture illustrated by slides and films on "Some Hydro-electric Possibilities and Achievements," by W. A. Hatch, M.B.E.

Birmingham.—Grand Hotel, 12.30 for 1 p.m. Birmingham Electric Club. Luncheon.

Monday, May 28th.—*London.*—Institution of Electrical Engineers, 7 p.m. London Students' Section. Annual general meeting.

Tuesday, May 29th.—*London.*—At Institution of Electrical Engineers, 6 p.m. Television Society. "The Human Eye and the Photocell," by Dr. W. Sommer.

Wednesday, May 30th.—*London.*—Royal Institution, Albemarle Street, 3 p.m. Society of Chemical Industry, Plastics Group. First Baekeland Memorial Lecture, "Leo Hendrik Baekeland—The Story of His Life," by H. V. Potter.

Birmingham.—James Watt Institute, 7 p.m. I.E.E. South Midland Students' Section. Annual meeting and paper on "Electrical Technique in Resistance Welding," by T. E. Calverley.

Arc-Furnace Transformers

Protection Against Small Over-currents and Short Circuits

By H. S. Aitken, A.M.I.E.E.

As a result of the great demand for high-grade steel for armaments, a large number of new furnaces have been installed, and the 24-hours-a-day duty imposed on most plants has put a considerable strain on the equipment, particularly on the circuit-breakers controlling the furnace transformers. Considerable research has led to the development of a protective control-system that has been found not only to reduce maintenance of switchgear but also to improve overall efficiency of the furnaces by eliminating unnecessary tripping.

An arc-furnace consists of a container holding the charge to be melted, into which automatically-controlled electrodes are lowered. The electrodes are fed from a low-voltage heavy-current transformer, and the charge is melted by the energy derived from an arc drawn between it and the electrodes. A three-phase supply is generally used, with one electrode in each phase.

There are normally two periods in the process of turning scrap-metal into molten steel, namely a breaking-down period and a refining (or holding) period. Over-currents often occur during the breaking-down period, when solid scrap causes short circuits by falling around the electrodes, and a series-reactor is usually included in circuit during this period to limit the current to between two and three times full load.

In the refining period the series-reactor is not used, or alternatively its ohmic value is reduced, since the molten condition of the metal makes short circuits unlikely. The few that do occur, however, give rise to higher currents than those in the first period.

The arc-current is normally maintained at a predetermined value by automatic control, which initiates the withdrawal of the electrodes when the current is greater than the predetermined value (*e.g.*, on the occurrence of a short circuit in the furnace) or the lowering of the electrodes when the current is below the predetermined value.

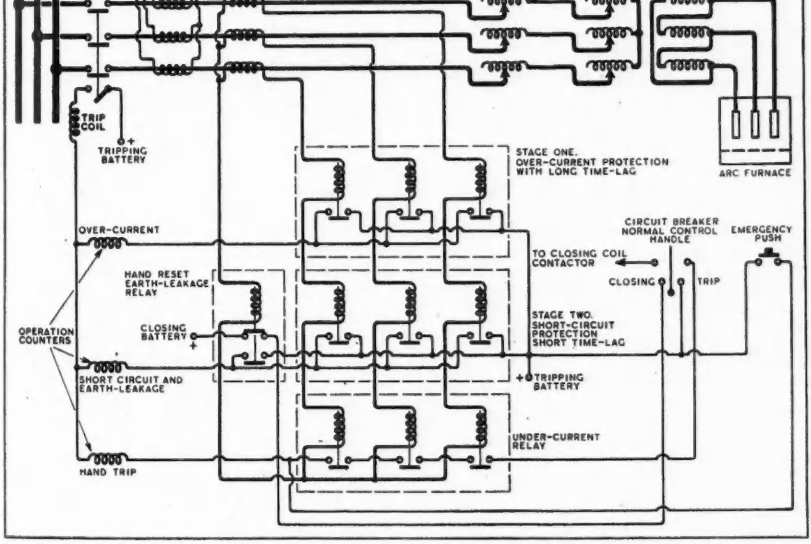


Fig. 1.—Arc-furnace protection control scheme for prevention of on-load tripping

It is usual to start breaking-down the metal at a comparatively high voltage (say 160 to 200 V) and to reduce the voltage in steps by transformer-tap change until, when the refining period is reached, it has dropped to about 100 V. Off-load tap-change equipment is used, and the circuit must be made dead before the tapping is changed.

Thus the circuit-breaker may have to operate many more times than one that controls an ordinary feeder or a transformer —possibly up to 40,000 times in a year; in addition to such routine operations there may be overloads and short circuits.

Arc furnaces have usually been protected by inverse and definite - minimum time-lag over-current relays, with or without instantaneous earth-leakage relays, but the usual low current settings and time settings may result in frequent over-current operations, with consequent increase of circuit-breaker maintenance.

Sometimes the current settings or the time settings are increased until over-current operations become few. Increased current settings, however, mean that relatively large currents may persist for long periods, or even indefinitely, during the breaking-down operation, while increased time settings may cause difficulty in obtaining satisfactory time-grading with the supply authority's over-current relays at heavy over-currents.

A protective scheme developed to protect the furnace transformer and associated gear from the effects of small sustained over-currents and short circuits is shown in Fig. 1. This scheme also avoids unnecessary circuit-breaker operation at over-currents and makes possible satisfactory grading with existing over-current relays protecting the supply system.

The conditions to be met are frequent small over-currents (two to three times full load) during the breaking-down period and a relatively few severe short circuits during refining. For both of these the automatic control initiates the withdrawal of the electrodes. In the first condition the over-current can usually be allowed to remain until it is sufficiently reduced by electrode withdrawal. In the second condition, however, system-protection usually makes it impossible for a severe short circuit to remain in a supply system long enough for the electrode withdrawal to restore the current to normal.

To deal with the two conditions the scheme includes two relays, namely, an over-current relay (stage one) and a short-circuit relay (stage two), both with inverse and definite-minimum time-lag characteristics. The former has a plug-setting range of 50 to 200 per cent. with variable time-lag settings longer than those of a standard relay; the latter has a plug-setting range of 100 to 400 per cent. with standard variable time-lag settings.

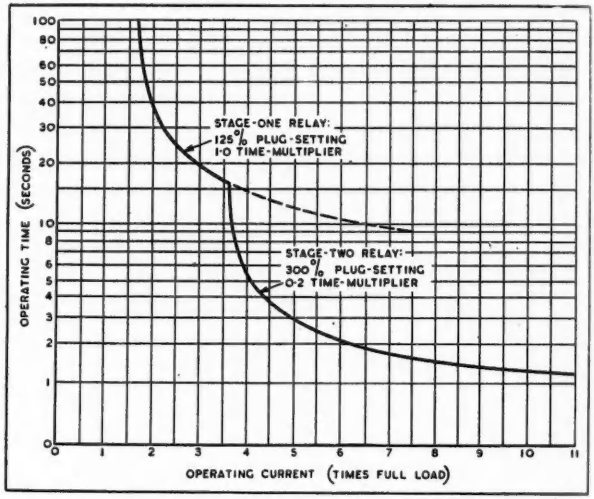


Fig. 2.—Time-current characteristic of combined stage-one and stage-two relays

The two relays together, with the settings shown in Fig. 2, have a time-current characteristic with long time-lags at small over-currents up to about 3½ to 4 times full load, after which the time-lags are relatively short. Individual requirements may necessitate relay settings slightly different from those stated, and each case should be considered on its merits.

It is of the utmost importance that over-current settings in the supply authority's network should be co-ordinated with those of the furnace relays. The long time-lag at small currents does not generally affect the settings of back-up relays in the network because of the larger current-transformer ratios further back in the system. All that is necessary, therefore, is to co-ordinate the

setting of the stage-two relay with those of the back-up relays. Whenever possible the stage-two relay is energised from the current transformers on the low-voltage side of the furnace transformers.

Sometimes an over-current relay can be connected to the current transformers on the low-voltage side of the furnace transformers. The stage-one over-current relay is then connected to these current transformers, and the stage-two relay to those on the high-voltage side. This arrangement gives improved over-current protection because the thermal rating of the transformer is generally fixed by the secondary winding, and since the ratio of the transformer varies with different tap-change positions it follows that the primary current is not always a measure of the secondary current, *i.e.*, of the thermal loading on the secondary side.

Earth-leakage protection is normally included in the high-voltage circuit. The relay should be instantaneous and hand-reset, and should have either a lock-out contact to prevent the closing of the circuit-breaker before the relay has been reset or a contact for operating a hand-reset alarm relay to initiate an audible warning.

In order to assess the maintenance period of the circuit-breaker, three counters record operations due to over-current, short circuit and earth-leakage, and hand-tripping. During the initial installation the circuit-breaker is examined frequently, but after a short time the need for maintenance can be assessed from the operation-counter readings.

Hand Tripping

In addition to avoiding unnecessary tripping with over-current, it is advisable, in order to minimise maintenance of oil-immersed circuit-breakers, to avoid hand tripping on load. Although the furnace operators may have been instructed to reduce the current to a minimum before opening the circuit-breaker for tap-changing by first withdrawing the electrode from the furnace, as a rule there is no automatic means for ensuring that this is done. The circuit-breaker may, therefore, be tripped frequently on load. An interlock scheme is therefore used which ensures that all tripping by hand takes place at no load (*i.e.*, with magnetising current only), experience having shown that contact wear and oil deterioration are then a minimum.

The interlock scheme, which is illustrated in combination with the protective scheme in Fig. 1, has a three-pole under-current relay connected to the current-transformers on the high-voltage side of the furnace-transformer and arranged to make contact when the current falls below a predetermined value. The contacts are in the hand-tripping circuit of the circuit-breaker so that tripping by hand is impossible while current is flowing through the primaries of the current-transformers. For tripping, the current must be reduced by withdrawing the electrodes from the furnace in order that the under-current relay may complete the tripping circuit, which it does at about 10 per cent. of full load.

A push-button is provided for tripping the circuit-breaker instantaneously in emergency. It is of the lock-in key-reset type, so that the operator cannot use it for normal tripping; the resetting key can be kept by a responsible person or in a locked glass-fronted case.

Although the extent of the reduction of switchgear maintenance by these schemes cannot generally be stated, in one typical installation the period between renewals of oil and change of contacts was increased from one month to six months. Acknowledgment is due to A. Reyrolle & Co., Ltd., for permission to publish information contained in this article.

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French Industrialists' Visit

CONVERSATIONS have taken place in London between a delegation of French industrialists, led by M. Fournier, president of the French Employers' Delegation, and the Federation of British Industries, under the leadership of Sir Clive Baillieu and Lord Dudley Gordon. The invitation to the French industrialists was extended by the Federation of British Industries with the approval of the Governments of both countries.

Both sides recognised the overriding importance to the European economy of a speedy solution of the fuel problem. They resolved to urge upon their respective Governments the essential need for all the authorities concerned—civil and military—to devote their immediate attention to restoring the production of all European coal mines and to give highest priority to allocating personnel, plant, machinery and transport facilities to the attainment of this object.

With regard to industry generally, they were strongly of opinion that production was best carried on under a regime of free enterprise rather than under a too rigid system of State control. Both delegations were of opinion that, while the retention of some measures of control would be necessary for the time being, the utmost vigilance should be exercised to ensure that their scope should be reduced as much and as rapidly as possible.

At the conclusion of the conversations the British proposed and the French warmly accepted the creation of a permanent Franco-British Industrial Liaison Committee. The main tasks of the Committee will be to continue and amplify the exchange of information that has taken place during the present talks and to arrange for further conferences.

During the visit a luncheon was given by Sir Clive Baillieu, president of the F.B.I., when Mr. G. S. Summers, M.P., Secretary of the Department of Overseas Trade, proposed the toast of the guests. The programme has also included a tour of bombed sites in the London districts and a visit to Oxford. A number of individual interviews have taken place between the French visitors and British industrialists.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Guarantees

WITH reference to Mr. F. S. Naylor's contribution to your issue of May 11th, I cannot claim the credit for the index of ratio between capital outlay on mains and services. It is the legal one set out in Sections 25 and 27 of the Electric Lighting (Clauses) Act, 1899, and this prescribes a figure of 20 per cent. I have merely endeavoured to show that it should be 40 per cent. or thereabouts.

Speaking generally, a low ratio obtains where the consumption per consumer is low and the average price high and *vice versa*, *i.e.*, the higher the ratio the greater the development of the undertaking, since a greater consumption per consumer means a greater revenue and equally a greater expenditure, mainly in the purchase of bulk supply to meet the greater demand.

A high ratio is, as a rule, a healthy sign, and as the consumption per consumer goes up the average price per kWh comes down, but the margin per kWh also comes down. You either sell a low number of kWh per consumer with a big margin or a high number with a small margin. With a well-developed undertaking with a low average price, any new consumer with a low consumption does not provide the necessary margin to be self-supporting; the loss to the undertaking, having to be made good by other consumers, negatives the benefits these would receive. Prices therefore cannot be reduced (and might have to be raised) unless the increasing consumption of existing consumers overwhelmingly outbalances the low consumption of new consumers.

Even if no new consumers were connected for a period of years, further capital outlay on mains reinforcement would be necessary in order to meet the increasing demand of existing consumers, and this would partly discount savings from time-expired capital expenditure. Moreover, other expenditure would increase, such as cost of bulk supply, wages, maintenance and rates. The additional kWh would probably be sold at a low rate, leaving only a small margin of profit, which would be quickly dissipated unless adequate consumption is guaranteed by new consumers. With continually rising costs the continued acceptance of unremunerative consumers will have to be considered.

As to Mr. Ferns' last letter, official records of the Wolverhampton undertaking show that in 1927-28 the revenue (excluding bulk) was £221,156, which was 63 per cent. of the capital outlay on mains and services, £348,522. In 1937-38 the revenue was £476,987, which was 50 per cent. of the mains and services figure of £945,657. The ten-year increase in revenue therefore provided 42 per cent. as the necessary revenue from the additional outlay. If 20 per cent. was obtained from new consumers and the balance from existing consumers, their ratio was raised to 100 per cent. and to this extent they subsidised the new consumers. If only 50 per cent. of the increase was attributable to new consumers, and the balance to existing consumers, the former's ratio is still 42 per cent. and the latter's 54 per cent., thus again providing a subsidy.

For 1937-38 the total revenue (including bulk) was £508,434 and the total cost of electricity purchased was £276,611, leaving £231,823 to cover all other costs. The ratio is thus 24·4 per cent. in respect of the total capital outlay on mains and services. How can 20 per cent. be sufficient when even with electricity free of charge it requires 24·4 per cent. on the outlay to maintain the service? The difference between Mr. Ferns and myself is essentially that he is satisfied with connecting thousands of unremunerative consumers, whereas I am not.

*London, W.C.*2. F. W. PURSE.

Freedom of Choice

IN your issue of April 20th, Dr. L. E. C. Hughes writes of the fluctuations in pressure which make gas unsuitable for cooking, as compared with electricity. He further states that the basic heating of houses should be by gas since thermostatic control irons out the fluctuations in pressure. Modern gas cookers are also thermostatically controlled and therefore are *not* subject to fluctuations in pressure. They are also fitted with pressure governors and are serious competitors of electric cookers. If we accept Dr. Hughes' contention that gas should be used for basic heating of houses it should also be used for cooking.

*London, N.*1. W. ELLERD-STYLES.

Too Many Catalogue Sizes

AGREED. But the trouble is that "Everybody's out of step except our George." Nothing but a Government Order would be effective, and then, probably, we should all take great pleasure in dodging the order in one way or another. Better try standardising the length of a piece of string first.

Norwich. T. J. BARFIELD,
Publicity Manager,
Laurence, Scott & Electromotors, Ltd.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Committee of the Radio Section of the Institution of Electrical Engineers has made the following nominations to fill the vacancies which will occur on the Committee on September 30th:—Chairman, **Mr. A. H. Mumford,** B.Sc.(Eng.) (Post Office Engineering Department, London); vice-chairman, **Mr. F. Smith,** O.B.E. (M.O. Valve Co., Ltd.); ordinary members of Committee, **Mr. G. E. Condliffe,** B.Sc. (Electric & Musical Industries, Ltd.), **Mr. D. C. Espley,** D.Eng. (Research Laboratories of the G.E.C., Wembley), **Mr. C. E. Strong,** B.A.I. (Standard Telephones & Cables, Ltd.).

Mr. P. S. Grant (Teignmouth Electric Light Co. and Dawlish E.L. & P. Co.) has been nominated as chairman of the I.E.E. Devon & Cornwall Sub-Centre for 1945-46, and **Mr. H. C. Widlake** (Plymouth & Stonehouse Gas Co.) as vice-chairman.

Mr. G. O. Edwards, A.M.I.E.E., has been appointed borough electrical engineer and manager at West Bromwich, where he at present holds the position of deputy. The vacancy is caused by the appointment of **Mr. F. Jasper Cole** as borough electrical engineer and manager at Blackpool.

Mr. Thomas Coates, M.Eng., M.I.E.E., A.M.I.Mech.E., whose appointment as deputy city electrical engineer of Liverpool we announced last week, has been with the Liverpool Electric Supply Department since 1934 when he was appointed assistant technical engineer. He became chief technical assistant in 1936. In September, 1939, he joined the Fleet Air Arm as a pilot, attaining the rank of lieut.-commander (A.), R.N.V.R., and was released in 1943 at the request of the Corporation. He was educated at Oundle School and Liverpool University, and served his apprenticeship with the Metropolitan-Vickers Electrical Co., Ltd.

Mr. T. Coates

Councillor John Atkinson, who is on the staff of the North-Eastern Electric Supply Co., Ltd., has been elected chairman of the Darlington Rural District Council.

Mr. F. H. Barnett, consumers' superintendent with the Bradford Corporation Electricity Department, is retiring after forty-one years' service.

No fewer than 101 employees of W. T. Henley's Telegraph Works Co., Ltd., recently received long-service certificates for twenty years' service at the company's Gravesend works. Mr. E. E. Judge, works manager, presided, and the presentations were made by Sir Montague Hughman, chairman of the company. This was the largest gathering of its kind held at these works, and Dr. P. Dunsheath, the chief engineer, mentioned that in all 1,500 certificates had been awarded. Afterwards **Mr. R. C. Fox** received from the chairman on behalf of the company a gift of War Savings Certificates and a framed copy of a resolution of the board in appreciation of his fifty years' service. Personal gifts from Sir Montague and Lady Hughman to Mrs. Fox were also presented.

Mr. H. John Wright, A.M.I.E.E., charge engineer to the Ipswich Corporation Electricity Department, has signed a three years' contract for the post of power house charge engineer with the Anglo-Iranian Oil Co., Ltd., at its power station at Abadan. Mr. Wright went to the Ipswich undertaking in 1924 as an apprentice, being appointed rotary sub-station attendant in 1929, combustion engineer in 1930, relief shift engineer in 1933 and charge engineer in 1936. He attended the Ipswich Municipal Secondary School and the Ipswich School of Engineering.

Mr. H. J. Wright

Ferranti, Ltd., recently bought the whole of the 2,300 seats in a Manchester theatre for a circus performance, seat tickets being sold to the employees at the firm's various works in order to swell the fund to buy comforts for the crew of the Canadian frigate, *Loch Polick*, which the company has "adopted."

Mr. Robert Bell, M.I.E.E., A.M.I.Mech.E., informs us that he has resigned from the position of borough electrical engineer and manager at Congleton consequent upon his appointment as deputy borough electrical engineer at Barking.

Mr. R. A. Jackson, A.M.I.E.E., assistant distribution engineer with the Croydon Corporation electricity undertaking, has been appointed mains superintendent to Erith Electricity Department.

Mr. C. S. Youatt, chairman and managing director of Rhodes Brydon & Youatt, Ltd., is to be this year's president of the Manchester Association of Engineers.

Mr. Herbert Vickers, Ph.D., M.Eng., A.M.I.E.E., who is now acting as consulting engineer on the design of small motors to S. Smith & Sons (England), Ltd., was for the four years from 1940 to 1944 engaged with Campbell & Isherwood, Ltd., upon the design of equipment for the Admiralty. Dr. Vickers has had extensive experience in the educational and manufacturing spheres. He was at the University of Columbia, Vancouver, for over twelve years where he held the post of professor and head of the departments of electrical and mechanical engineering, and he has also taught at Finsbury Technical College, East London

College, and Bristol and Birmingham Universities. His manufacturing experience has included periods with Siemens Bros. (Stafford), Metropolitan-Vickers and J. H. Holmes & Co. He has acted as consulting engineer to the B.C. Electric Railway Co. and has written a book on the induction motor which was translated into Russian. Later this year, Dr. Vickers tells us, he intends to commence practising as an independent consultant.

Sir Donald Fergusson has been appointed Permanent Secretary of the Ministry of Fuel and Power in succession to **Sir Frank Tribe,** who has been appointed Permanent Secretary of the Ministry of Aircraft Production.

Miss Joan Bridgen, B.Sc. (Econ.), daughter of Mr. C. W. Bridgen, a director of Ferranti, Ltd., was married at St. James's Church, London, W.1, on April 30th to **Mr. Janusz Szczepanowski,** B.Sc. (Econ.), of the Polish Army.

The staffs of the Glasgow office and Edinburgh and Dundee depots of the B.T.H. Company met recently to do honour to **Mr. R. McAllister** on his retirement after forty-five years' service with the company. Mr. Miller, manager of the Glasgow office, after referring to his very friendly and close relationship with Mr. McAllister during his own managership, handed him a cheque on behalf of his colleagues, and also a drawing by Mr. A. Edward, of the Glasgow stores department, with the signatures of the members of the various staffs at Glasgow, Edinburgh and Dundee.

Mr. R. McAllister

Bedford Corporation Electricity Committee recommends an increase in the salary of **Mr. P. G. Campling,** chief engineer and general manager of the Electricity Department, from £1,787 to £2,000 per annum in recognition of the valuable services he has rendered since his appointment.

Mr. H. W. Puttick, M.I.E.E., M.I.Mech.E., chief electrical engineer of the North Western Railway, India, has arrived home on leave preparatory to retirement. His address is: 17, Aubrey House, Maida Avenue, London, W.2 (telephone: Paddington 4165).

Prof. R. O. Kapp will lecture on "The Future of Domestic Heating and Lighting" in the Anatomy Theatre of University College, London, on Tuesday, May 29th, at 1.15 p.m. No fee or ticket is required. This lecture was originally arranged for May 8th, but was postponed on account of the national holiday.

The I.E.E. Transmission Section meeting fixed for May 9th, was also cancelled. The paper by **Mr. J. H. Savage** on "Localisation of Faults in Low-Voltage Cables, with special reference to Factory Technique," is now to be read at a meeting of the Section on Wednesday, May 30th, at 5.30 p.m.

Mr. J. E. Wright has been appointed secretary to E. R. & F. Turner, Ltd. (incorporating Bull Motors).

Mr. Mark Denne has been appointed a director of the Telephone & General Trust, Ltd.

Hastings Corporation is advertising in this issue for a borough electrical engineer and manager to succeed **Mr. A. J. Ryan** who is retiring.

Applications are invited for the position of assistant power station superintendent at Coventry (£593 rising to £622 per annum) and for a constructional and development engineer at Poplar (£545 per annum).

Obituary

Mr. E. M. Pearson.—We are very sorry to learn of the sudden death on May 6th of Mr. Ernest Middleton Pearson, A.M.I.E.E., chief assistant electrical engineer to the York City Electricity Department.

Sir William G. Max-Muller, chairman of the Bagdad Light & Power Co., Ltd., has died at the age of seventy-seven.

Ash-sluicing

LOW-PRESSURE ash-sluicing systems, with particular reference to power station practice, is the subject of a paper compiled by MR. T. H. CARR (electrical engineer and manager, Bradford Corporation) for the Institution of Mechanical Engineers.

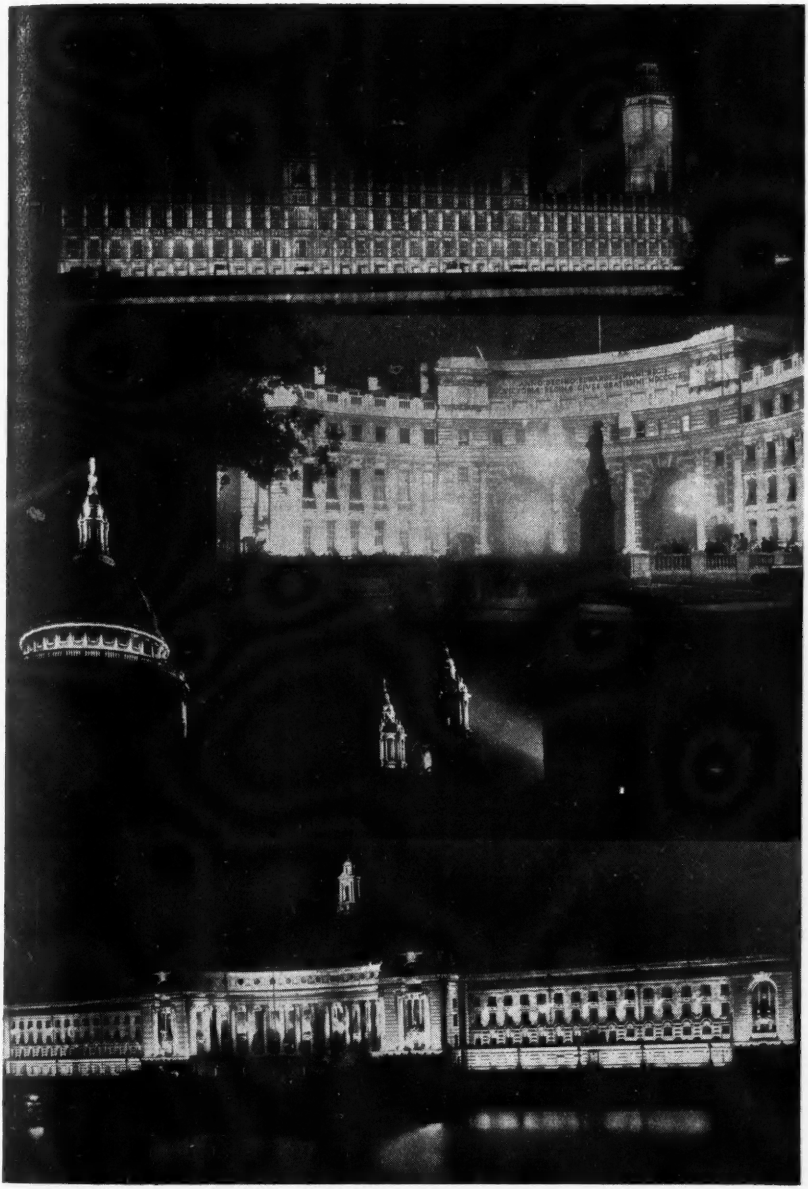
The purpose of the paper is to outline salient features of the method and to discuss some of the difficulties encountered with the recirculating water pumps and associated equipment. The author introduces the subject with a general consideration of factors affecting the design of ash plant, including its position with respect to the rest of the power station, the best type of plant to employ and the generation working conditions of the station itself. There follows a general description of low-pressure systems of water-sluicing ashes and methods of disposing of the residue. Physical characteristics of boiler ash are considered in some detail, typical ash and grit analyses being included.

Space is devoted to those features which require particular attention in order to secure the best operating results, one of the most important being the corrosion of the ash-handling plant. The author gives details of the loss of metal in such circumstances and explains the results of carefully controlled tests. He outlines the chief desiderata in the design of troughs and pumps, concluding with some useful information about the costs of operation and maintenance of ash-handling plant.

AC Generator Protective Systems

THE electrical protection of AC generators is the subject of a paper prepared by Mr. D. A. Daoud and read by Messrs. P. W. Castle and G. Lyon before the London Students' Section of the I.E.E.

The paper is descriptive; it first classifies the types of fault that have to be guarded against and then describes at greater length the various systems of protection that may be applied, reference also being made to the routine appropriate to the periodical testing and checking of the protective gear. The expenditure on adequate protective gear is of the order of 5 per cent. of the cost of the generator it safeguards.



VICTORY WEEK FLOODLIGHTING.—*The Houses of Parliament, the Admiralty Arch, St. Paul's Cathedral and County Hall.*

Views on the News

Reflections on Current Topics

WITH the war in Europe over and many doubts and uncertainties resolved, electrical manufacturers can look forward with confidence to a return to their peacetime activities. A considerable quantity of materials will, of course, still be required for the war in the Far East, but manufacturers should find themselves with a considerable surplus of productive capacity for making their normal goods. Actually, I believe, the electrical industry has expanded about 80 per cent. during the war and of the 180 per cent. production figure about one-half has been war work. With the slackening or cessation of war contracts difficulties are likely to centre mainly on scarcity of skilled labour since many of the workers freed from making armaments are quite unsuited to the manufacture of electrical apparatus. Up-to-date though most of the machine tools installed during the war are, a considerable proportion of them are unlikely to be suitable for peacetime requirements.

* * *

I have been trying to find out what is happening about the British Industries Fair. Last December, the late Mr. Harcourt Johnstone, Secretary to the Department of Overseas Trade, said that the first Fair would be held as soon as possible after the defeat of Germany; this might be in the spring of 1946, but that it might not be possible to stage a really successful Fair until the following year. The D.O.T. could only tell me when I inquired that a statement would be made on the matter shortly. I rather gather that the electrical industry as a whole would prefer to postpone the holding of the Fair until 1947 as there would be no time to produce new prototype models in time for an exhibition next year and it might not even be possible to turn out pre-war types of apparatus in a sufficiently impressive array. Whenever the Fair is held, I have heard it suggested that May or June would be a better time than February and that London is a more suitable venue than Birmingham. These, of course, are by no means new proposals.

* * *

Mr. G. Leslie Wates, chairman of Johnson & Phillips, Ltd., stated at the company's annual meeting last week that "the intention in general terms of the Government to take over in some form or another the electricity distribution undertakings of the country had been confirmed on more than one occasion recently." No doubt some changes in the distribution side of the supply industry are to be expected and, while agreeing with Mr. Wates that it is unlikely that any precise scheme will be formulated until after the General Election, I should be very surprised, unless the Socialist Party secures an overwhelming majority, if reorganisation were to go to the length of "taking over" distribution. I don't like to prophesy but it seems most likely to me after studying the whole history of evolution of the electricity supply industry that a compromise solution will be reached, following to a certain degree the lines suggested by the McGowan Report, which after all is the most comprehensive and authoritative survey of the problem which has yet been made; little has happened since its publication to invalidate its findings and recommendations.

* * *

After five and a half years of black-out, dim-out, "star" and "moon" lighting, last week's floodlighting was a welcome sight. Admittedly it has not been extensive or elaborate but that is scarcely to be wondered at. Apart from the uncertainty of the date of VE-Day, no floodlighting lamps have been made since the beginning of the war and few, if any, were available for replacements, let alone for new installations. Projectors too cannot have been improved by their enforced idleness. Still, any defects there may have been were overlooked by the enthusiastic crowds enjoying the unaccustomed brilliance. Incidentally, the ingenious way householders have adapted bowl fires as projectors seems to indicate a promising market for domestic floodlight fittings.

* * *

There is a school of thought which holds that the less a man knows about a subject the more suitable he is for membership of a committee dealing with that subject. The contention is that such a man is more likely to be impartial and unbiased than one who brings expert knowledge to the task. Fortunately this idea does not always prevail and most committees have at least a proportion of members with experience of the subject being dealt with. I am prompted to these remarks by a report of a municipal council meeting at which the appointment of a representative to a joint electricity authority was discussed. The selection for the appointment of a local electrical engineer and contractor was objected to by an alderman and in consequence it was decided by the Council that the recommendation should be "taken back" by the committee concerned.

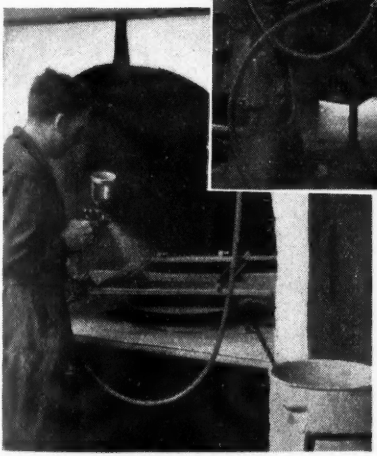
—REFLECTOR.

Making Standard Cookers

How the Units for M.O.W. Emergency Houses are Produced

A DESCRIPTION of the standard electric cooker which a group of manufacturers is producing for use in the prefabricated kitchen units for the Ministry of Works emergency houses was given in our issue of February 16th. Orders have now been placed for 31,000 of these cookers and production is beginning to get into its stride. A few days ago we visited the Creda Works, Oldbury, where the Simplex Electric Co., Ltd., one of the manufacturers concerned in the production of the units, has just completed its first quota.

Production is at present laid out for manufacturing about 200 a week and it was indeed pleasant, after a virtual cessation of production during the war, to see cookers being made in comparatively large numbers once again. Apart from a few components such as thermostats and switches, the complete cooker is made by the company. The hobs, oven and hot-cupboard doors, front and skids of the cookers are castings which are made at the company's Broadwell Works, but are machined in the well-equipped machine shops of the Creda Works.



Spot welding the oven interiors and (left) spraying a hob with vitreous enamel

For making the sheet-metal parts which form the rest of the body of the cooker, 150-ton presses are employed, the various sections of the oven interiors being spot-welded together.

Before being vitreous enamelled, the surface of the castings is prepared by blasting with angular steel grit blown on by air at a pressure of 60 lb. per sq. in. The sheet metal components are prepared for vitreous enamelling in a different way, passing in succession through baths of trichlorethylene, a solution of acid, running water and a neutralising solution. Hand spraying is used entirely for coating the hobs

with enamel but the sheet metal work is first dipped and then finished off by spraying. Drying of the enamel is carried out as quickly as possible in dryers heated to a temperature of 120 deg. F., and fitted with fans. The time taken for drying varies according to the nature of the work in process. Having reached what is termed the "biscuit stage," the various components are placed on twin mechanical charging "forks" for feeding into the furnaces, where the castings spend approximately 20 min. at a temperature of 760 deg. C., and sheet metal components 3 to 7 min. at a temperature of 860 deg. C. Constant check is kept on the temperatures by the use of both instantaneous reading and recording thermometers. Incidentally, the waste heat from the furnaces is used for the dryers already mentioned.

A twin mechanical charger feeding hobs into a vitreous enamel furnace

Special departments handle the production of oven elements, hotplates, grill boilers, etc. Three sub-assembly lines deal with the hot-cupboard units, the oven interiors (including the fitting of the plug sockets for the hot-plates, grill boilers and oven elements), and the wiring sets, comprising switches and wires cut to length and loops made. The oven is then bolted on to the front member and lagged with slag wool. Skids are then put on the base and the doors added. In the main assembly lines, of which there are three, the sequence of operations consists of the installation of the switches, thermostats and wiring; packing of the oven door; fitting the hot-cupboard door, hob, hot-plate and grill; and inserting the oven elements, loose interior sides and bottom. After testing the wiring and electrical components the front bottom panels are added and the complete cooker is ready for packing and dispatch.

Making oven elements and (right) the sub-assembly lines

The production described is of course occupying only a small portion of the company's capacity, which is still chiefly engaged on essential Government contracts. It was pleasing, however, to see that, so far as the prior claims of this more essential work allowed, signs were evident that the works are slowly getting back into their stride in the production of cookers of the company's own design and of other domestic appliances, including irons, fires and kettles.

We thank Simplex Electric Co., Ltd., for permitting us to visit its factory, and also Mr. S. Smart, commercial manager of the Creda Works, and his colleagues for assisting us in the preparation of this article.

Resistance of Copper Castings

Measurement of Very Low Values by Millivolt Drop

By
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Electrical Engineer and Transformer Designer, A.I. Electric Welding Machines, Ltd.

EXPERIENCE gained by the author in the course of the design and manufacture of transformers for use in resistance welding machines may be helpful to those concerned with the measurement of the electrical resistance of copper castings used for the secondary circuit. In the first place the value of the resistance should be checked before use, because it is not wholly dependent on the specific resistance of the metal. It is influenced by two factors—first, the steel cooling pipes inserted while casting and, secondly, the possible presence of blow holes; it is best, therefore, to take the resistance of the finished casting and not to rely upon a reading taken on a sample rod of the same cast.

The resistance of one casting may be as low as 0·000001 ohm, and for such low values there are two main methods, *viz.* the voltage drop for known current passed through the secondary and the Kelvin double-bridge.

Voltage-drop Method

A good explanation of the voltage-drop method is contained in a paper by C. H. Ridsdale on "Electrical Testing of Conductivity Steel" in the *Journal of the West of Scotland Iron and Steel Institute*, 1916. This paper deals with the measurement of resistance of steel rails and explains the volt-drop method as recommended by W. Phillips (Elliott Bros.).

For commercial work an accuracy within about 2 per cent. is usually sufficient and is readily obtained when using good measuring instruments with the volt-drop method, provided sufficient current is passed through the secondary to obtain a drop in millivolts (not microvolts).

This method ensures minimum error due to contact voltage. It is also of considerable help if the instruments are made with copper terminals and plain untinned copper wire is used for connection from the secondary heads to the millivoltmeter. The bolts for connection to the secondary heads should be brass or copper (and not steel) with brass or copper washers.

Connections for the main current are not so important; usually a good size of cable socket would be used to ensure no local heating during the test. The connection for main current must be distinct from the connection to the millivolt circuit; this calls for two separate holes in each secondary head.

The lengths of lead must be kept to a minimum between secondary heads and millivoltmeter terminals, but it may be necessary to make a correction for the effect of the resistance of these leads.

It is advisable to have a "standard" resistance for comparison, and this can conveniently be a length of high-conductivity copper bar of about the same resistance as the "unknown" secondary casting. This standard bar is preferably connected in series with the castings before commencing the test with its independent millivolt (or potential) points at a measured distance apart.

Two readings are taken in quick succession, first on the unknown casting and then on the standard bar. The resistance is then worked out and the standard is checked to see that its resistance is within 1 per cent. of the known specific resistance of h.c. copper.

Kelvin Double-Bridge Method

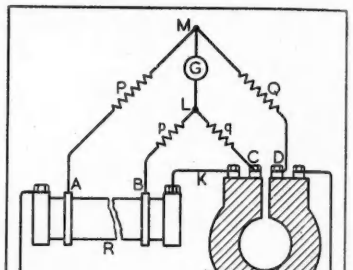
The Kelvin double-bridge method has its limitations. The instrument may be purchased from a reliable manufacturer and—for a certain range of resistance—would give good results without trouble; but that does not apply to such low resistances as 0·000001 ohm, particularly when leads must be taken from the casting to the instrument. The resistance of such leads will certainly interfere with the accuracy.

The resistance of the connection between the standard and the unknown resistance is

included in the formula for use with the Kelvin double bridge, but this formula is sometimes incorrectly stated. The correct formula is $X = \frac{RQ}{P} - Kp\left(\frac{\frac{q}{p} - \frac{Q}{P}}{p + q + K}\right)$, where X is the resistance between points C and D in the accompanying diagram, R is resistance (adjustable) between A and B, K between B and C, P between A and M, Q between D and M, p between B and L, and q between C and L. A single heavy-current cell is indicated by E and a galvanometer or micro-ammeter by G.

This formula is correctly stated in Gray's "Absolute Measurements in Electricity and Magnetism" (1888), Vol. 1, p. 361, and in handbooks copying it. (Gray was an assistant of Kelvin's.) It is also given correctly with derivation on pages 719 and 720. of "Dictionary of Applied Physics," Vol. 2 (1922), but not on page 698, where R should read K in the denominator after p plus q.

Of the two methods, the millivolt-drop with DC amperes is recommended for the very low resistances under consideration. This method is also useful when the resistance of the complete secondary circuit has to be taken on the completed welding machine between the two electrode blocks.



Circuit of Kelvin double-bridge

Supervising Engineers' Papers

Prizewinning Entries Reviewed

THREE prize-winning papers in the March competition of the Association of Supervising Electrical Engineers were submitted to the May meeting in London.

District heating is dealt with in a paper (awarded first prize) by MR. J. F. BRIDGE (of Manchester). He calculates that there would be sufficient "waste" from a typical 50,000-kW turbo-generating station to furnish 4,900 five-roomed houses with central heating and hot water for domestic purposes. The hypothetical scheme considered appears to indicate that district heating at 4·5d. per therm would show annual savings of £123 as compared with the use of solid fuel at 50s. per ton, or £1,112 with electricity at 0·5d. per kWh, or £1,362 with gas at 1s. per therm, without taking amenities and incidental benefits into account.

The keeping of records for plant maintenance is the subject of the second-prize paper by MR. C. RHODES (of Leeds), who describes a scheme which is functioning quite well in works consuming 15 million kWh per annum and utilising 1,000 motors of from fractional sizes up to 400 HP, cranes, hoists, electric trucks, welders, etc., and lighting in accordance with the Ministry of Supply recommendations.

The system is divided: the first part takes care of installation, materials, spares, etc., while the second section records the histories of machines and the way they are treated. The last-mentioned aspect is considered to be most important, since records must be kept in order to check mishandling and rough usage.

Post-war domestic installations are discussed in the third-prize paper by MR. F. S. IBBS (of Liverpool), who mentions contrasting attitudes. One is that pre-war practice should be abandoned and fresh ideas formulated on entirely new lines, while the other seeks to retain all that has been proved to be good and to endeavour to improve upon it. The latter is the attitude adopted by the author of the present paper, who proceeds to review four existing systems of wiring, pointing out their respective merits and weaknesses. In enumerating the minimum requirements he expresses the opinion that the proposal to install refrigerators in all post-war houses cannot be justified. It presupposes much wastage of food through inability to keep it cool, which he says is not the case, at any rate in the north of England. He classifies refrigerators as a luxury.

The author calls for more use of two-way and intermediate switching of lamps and a sufficiency of socket outlets. There are far too many different types of the latter in use; if they are to be modified for the inclusion of a fuse (the proper position of which he considers to be in the plug), then it is more logical to design a completely new standard outlet, which should be installed not less than 1 ft. above floor level. The best way of wiring the large number of outlets desirable is, he thinks, on the ring main system, possibly round the first floor with tappings up and down as required, in light gauge steel conduit (welded and enamelled), with grip fittings having machined entries, the conduit to be earthed before the v.i.r. cable is drawn in.

Institution of Factory Managers.—The Sir Henry Fildes Medal will this year be awarded to the best essay on "Training for Factory Managers: Practical, Administrative, which should be first and why?" Full details are obtainable from Mr. Charles Brown, general secretary, 63, Gayton Road, Harrow.

COMMERCE and INDUSTRY

Application of Tribunal's Award. Supply Companies' Merger.

War Damage Insurance

THE Board of Trade announces that the issue of policies of insurance under the Commodity Insurance, Business and Private Chattels Schemes has ceased. Current policies will remain operative until their dates of expiry.

Purchase Tax Exemption Withdrawn

The Purchase Tax (Suspension of Registration Limit) Order, 1945, which will come into operation, subject to the approval of the House of Commons, on July 1st, abolishes the present exemption from registration and tax of small manufacturers and others whose sales of goods liable to Purchase Tax do not exceed £500 a year. Accordingly all persons whose business (whether it is a full- or part-time occupation) includes the making and selling of goods liable to Purchase Tax will now be required to apply for registration unless they are already registered. The necessary form of application, P.T. 1 C., together with a list of goods liable to Purchase Tax may be obtained from any officer of Customs and Excise or from the Secretaries' Office, Customs and Excise, City Gate House, Finsbury Square, London, E.C.2.

Interpretation of Wages Award

Difficulties have risen in connection with the recent award by the National Arbitration Tribunal of a 4s. 6d. per week increase in the basic wages of adult male employees in the engineering industry. The workers and their unions maintain that the increase should apply to both time- and piece-workers and that bonuses should be calculated on the new basic rate. To this contention the employers do not agree and it is reported that the unions are taking steps to secure an interpretation of the award from the Tribunal. One outcome of the dispute is the decision of about 17,000 employees at the Trafford Park works of Metropolitan-Vickers to work on a day rate only, which means a considerable loss of production.

Local Holiday Arrangements

A recent arbitration award (No. 717) deals with a claim respecting local holiday arrangements and payment for work performed, the parties being the General Electric Co., Ltd., and members of the A.E.U. employed at the company's Bailiff Bridge works. The company's organisation in the Bradford area comprises six major units; five lie within the Bradford city boundary and the sixth, the Bailiff Bridge works, is a quarter of a mile outside. For the company it was stated that all six units were treated as a single undertaking and the terms of the national agreement and the local Bradford district agreements as to payment for holidays were observed. The A.E.U. contended that it was not competent for the employer to negotiate holiday arrangements in respect of the Bailiff Bridge unit other than with the Union's Halifax district secretary. The effect of the transfer of the holiday period to July 14th-24th, 1944, was to deprive the Bailiff Bridge unit of the payment of premium rates in respect of August 15th and 16th, 1944, which formed part of the recognised holiday period under the local Halifax district agreement. The Tribunal awarded against the claim.

Workers Transferred to Mills

Four hundred women and girls employed by Ferranti, Ltd., at its Moston works have protested against being transferred to work in cotton mills. Their main objections are said to be the low wages and unsatisfactory conditions, and in many cases the absence of welfare organisation.

Travelling Time

In September last, as the result of negotiations between the Electrical Contractors' Association and the Electrical Trades Union, a new agreement was drawn up by the National Joint Industrial Council for the Electrical Contracting Industry. This provided, *inter alia*, for the establishment of a national travelling time clause to take the place of existing local clauses, excluding only London, Manchester and District, and the Mersey District. As the result of further negotiations it has now been agreed that Clause 6, Sub-Clause (3), shall not apply to men who are taken into the service of the employer on the site of the contract as the result of a direction by the Ministry of Labour and National Service. Such men are to continue to receive payment in accordance with the agreement of July, 1939, as amended in July, 1943, until such time as direction ceases or a decision to terminate the agreement is made by the N.J.I.C.

Supply Companies' Amalgamation

A joint application has been made to the Electricity Commissioners for a Special Order authorising the transfer to a new company (to be formed for the purpose) of the undertakings of the Mid-Cheshire Electricity Supply Co., Ltd., and the Mersey Power Co., Ltd. On the completion of certain formalities, the directors will announce details of a scheme for giving effect to the amalgamation of the two companies.

Copies of the draft Order can be obtained (at 1s. each) from the offices of the companies, from the solicitors, Cobbett, Wheeler & Cobbett, 49, Spring Gardens, Manchester, or from the Parliamentary agents, Rees & Frères, 9 Victoria St., London, S.W.1. Any objections respecting the application must be sent to the Electricity Commissioners on or before June 11th.

Licences for Non-Ferrous Metal

The Ministry of Supply announces that applications to the Non-Ferrous Metals Control for licences to acquire copper and zinc for U.K. consumption will now be considered by the Control without restrictions in respect of the type of article to be manufactured. Certain restrictions on the release of copper and zinc will, however, continue to be imposed as regards export orders. The statutory provisions regarding

the acquisition and disposal of these metals are still in force and the present procedure of submitting to the Non-Ferrous Metals Control, Grand Hotel, Rugby, schedules of orders with applications for licences must be followed.

Glass Protection Order Revoked

The Minister of Labour and National Service has made an Order revoking the Factories (Glass Protection) Order, 1940, requiring occupiers of factories in which more than 250 persons are employed to provide safeguards to afford protection for workpeople against risk from injury caused by broken glass from windows, skylights, etc.

Surplus Machine Tools

In connection with the new arrangements for the disposal of Government surplus machine tools a complete record is to be maintained in Belfast of all the surplus Government machines lying in Northern Ireland which are available for disposal. Full information can be obtained from the Machine Tool Control Regional Office, Law Court Buildings, Chichester Street, Belfast.

Cookers for Russia

Elsewhere in this issue some particulars are given of the production by the Simplex Electric Co., Ltd., of the new standard cookers for emergency houses. During our visit to the company's Creda Works we saw a number of other activities in progress. A notable item was a batch of equipment for hospital use in Stalingrad, including nine large double oven units and a number of boiling rings. The accompanying illustration shows the double-oven units in course of assembly.

Large double ovens being assembled for dispatch to Stalingrad

Trade Publications

Petters, Ltd., Loughborough, Leics.—Illustrated leaflets containing specifications with dimensions, sizes and descriptive details of super-scavenge oil engines, series V, of from 150 to 540 BHP; publication D.196 deals with semi-portable generating sets incorporating Brush alternators, while D.192 is concerned with marine auxiliaries, electricity generating sets and direct propulsion of smaller vessels; D.188 is a report of performance tests by consulting engineers.

Britannia Batteries, Ltd., Windsor House, 29, Victoria Street, London, S.W.1.—Priced leaflet (No. 60) descriptive of switch-tripping equipments housed in sheet steel cubicles. The charger, test gear and instruments are contained in an upper compartment, while the lower section accommodates a 25-cell "Alklum" steel battery of from 5 to 55 Ah suitable for discharging from 15 to 165 A at 30 V.

Applicants for these publications should write on business letter-headings.

Calendar

As a thanksgiving token for victory the Electro Dynamic Construction Co., Ltd., has prepared a calendar-blotter for 1945-46 with a reproduction of an Etruscan bronze on the cover.

Changes of Name

George O'Kill & Co., Ltd., have changed their name to O'Kill, Mainwaring & Co., Ltd.

The name of the Southern Ignition Co., Ltd. has been changed to the Max Electric Co., Ltd.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered within one month from May 9th:—

DEEPENDARC. Class 9, No. B632,625. Electrodes and filler rods for use in electric arc welding.—International Welding Co., Ltd., 2, South Parade, Bedford Park, W.4.

WIREK. Class 9, No. B633,316, and REPROCORDER. Class 9, No. 633,317. Electrical sound recording and sound reproducing instruments. — Boosey & Hawkes, Ltd., 295, Regent Street, W.1.

HEXON. Class 11, No. 626,985. Electric heaters and electric lamps.—Horace Wooldridge, 41, Trevelyan Chambers, Boar Lane, Leeds, 1.

HYDULE. Class 11, No. 633,200. Electric lamps.—Thames Technical Co., Ltd., 83, High Street, Brentford.

PRIORY (design). Class 11, No. 633,174. Electric lamps and fittings therefor, which are not included in other classes.—Perry, Bevan & Co., Ltd., 133 & 135, Priory Road, Aston, Birmingham, 6.

OLICPRENE. Class 17, No. 633,415. Goods made principally of india-rubber, of synthetic rubber, or of gutta percha, all having a fabric base, for use as electrical insulating material and for use as packing and as jointing in the nature of packing.—Hall & Hall, Ltd., Oldfield Works, Hampton, Middlesex.

NEW BOOKS

Two British Pioneers. Practical Works Organisation.

Colonel Crompton. By J. H. Johnson & W. L. Randell (28 pp. ill.); and Frederick Henry Royce. By G. Geoffrey Smith (32 pp.). Longmans Green & Co., Ltd., 43, Albert Drive, London, S.W.19. Price 1s. each.

These are the latest of the "Science in Britain" series published for the British Council. In small compass they tell the fascinating story of the lives of two Englishmen whose work not only brought great advantage to their own country but had international significance.

The booklet on Crompton records his extraordinary versatility; electricity supply in its various aspects, machine design, military engineering, standardisation and tanks were some of the subjects which engaged his attention during his long active life. He was also, of course, a motoring pioneer.

Sir Frederick Royce in his earlier days was an electrical engineer. He was with a London electricity supply company for a time buf later commenced the firm of F. H. Royce & Co., electricians, in Manchester. He produced an improved form of dynamo and also embarked upon the production of electric cranes. About the turn of last century he became interested in automobiles and from that time, in conjunction with C. S. Rolls and Claude Johnson, he built up for his engines a reputation probably unequalled by those of any other make. Mr. Geoffrey Smith pays special tribute to Royce for the "Merlin" aero engine which, he says, is giving us fighter superiority and has done much to defeat the enemy.—J.H.C.

Factory Organisation and Management. By N. F. T. Saunders, B.Sc., M.I.E.E. Pp. 163. Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2. Price 10s. 6d.

This book is particularly helpful to students who desire a general knowledge of procedure in a large factory. It deals mostly with the organisation aspect and only lightly touches on the real problems of management. Although it uses large factory practice as a model, the book is unlikely to be consulted by executives in such premises but subordinate officials will find it useful in helping them to appreciate the problems of other sections than their own. Because the author has taken the easy and more simple method of assigning one person to practically each different function, it may be difficult for those in a small firm to decide how best to consolidate different functions in a few persons.

The author rightly stresses the importance of human relations, although he restricts himself to principles rather than applications. The chapter on wage systems deals with only two types and the statements on budgetary control tend to be too theoretical. The book is up-to-date in its mention of the effect of holidays-with-pay on overhead costs, but the examples of wage rates, i.e., 1s. per hour for an operative, are some years behind.

In dealing with control of materials, the importance of "chasing" is stressed, as well as the seldom appreciated fact that jobs often stand idle, waiting movement, for a longer period than they need for the operation itself. Mr. Saunders clearly brings out the lines of responsibility and deals concisely with the characteristics required of chief executives.

There are some ambiguities in the text, *e.g.*, "The organisation of sales activities differs considerably from that of a factory and they can each adopt exactly what arrangements they require without considering the other." Even if the two organisations are entirely separated, it is better that there should be correlation between them. To attain total maximum efficiency over the combination of sales and manufacturing, each may have to forgo something. The author states that the sales organisation is to be responsible for forecasting requirements and stocks of finished goods in the factory; this hardly seems to be in line with the above quotation from the text.

The book is better than many so-called "scientific management" publications, for it has obviously been written with a background of practical experience. It deals well with the economic aspects of primary and ancillary factories, but the reading is sometimes difficult because of unusual grammatical expressions.—G.V.H.

A Treatise on Applied Hydraulics. By H. Addison. 614 pp. 415 fig. Chapman & Hall, 37, Essex Street, London, W.C.2. 32s. net.

The third edition of this textbook by the Professor of Hydraulics at the Fouad I University, Giza, Egypt, has been revised and considerably enlarged by the inclusion of a number of explanatory notes and by additions to the bibliography. Applications such as the constructional features and performance characteristics of pumps and of various types of turbines with the particular sphere of each, transmission and storage of water and measurement occupy three times as much of the space as do fundamental hydraulic principles. This relationship, together with a large number of worked examples, makes the book of value to electrical engineers wishing to gain knowledge of generation by water-power in its more practical aspects.—C.O.B.

Machine Drawing and Design. By W. Abbott. Fourth Edition. Figs. 224; drawings. Blackie & Son, Ltd., 66, Chandos Place, London, W.C.2. Price 10s.

This book is written primarily for students attending technical schools and colleges, taking senior courses in engineering drawing and advanced courses in machine design or preparing for professional and university examinations in mechanical engineering. The new edition has been brought into line with the recommendations of B.S. 308, 1943, and additional matter on tolerancing has been included.

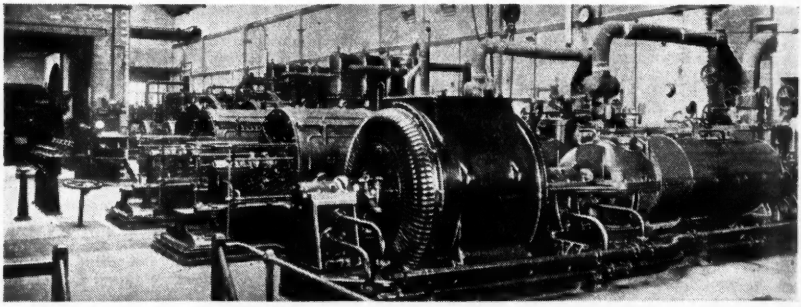
Book Received

Worked Examples in Electrotechnology. By W. T. Pratt, B.Sc. (Eng.) Lond., A.C.G.I., D.I.C., A.M.I.E.E. Pp. 262; figs. 158. Hutchinson's Scientific & Technical Publications, 47, Princes Gate, London, S.W.7. Price 12s. 6d.

Progress at Cheltenham

Electricity Undertaking's Jubilee

THE first step towards establishing a public electricity supply at Cheltenham was taken by the Town Council in 1888 and a Provisional Order was granted in 1890. Sanction having been obtained to borrow £16,000 to cover the cost of the initial plant, the power station at the destructor works was started up on April 9th, 1895, and was formally handed over to the Corporation by the contractors on May 16th, 1895. During the first three weeks (to May 1st) no charge was made to consumers.



View of the engine room at Cheltenham power station in 1922. The original sets installed in 1895 can be seen in the background and in the foreground there is a 1,000-kW machine installed in 1921. A 2,000-kW set was subsequently installed in 1924

The initial section of the power station was equipped with two 33-kW Siemens alternators generating at 2,000 V and driven by Willans vertical four-cylinder single-acting compound engines, together with a larger set having a 100-kW alternator. The steam-raising plant comprised two Galloway boilers rated at 5,000 lb. per hr. and operating at 120 lb. per sq. in. In order that steam at 65 lb. per sq. in. from the destructor could be used the two small sets were designed to develop their rated output at this pressure as well as to operate at the higher pressure when required. Extensions were made in the following year and from time to time until 1924 when the last, a turbine (W. H. Allen) geared to a 2,000-kW alternator (Electric Construction Co.), was put into commission. The station was closed down on October 14th, 1932. In 1925 the Electricity Committees of Gloucester and Cheltenham considered a proposal for the erection of a joint power station at Gloucester, but this did not materialise and Cheltenham consequently lost its protection under Section 13 of the 1926 Act.

The generating voltage of 2,000 V was maintained throughout the life of the station. Scott-connected transformers were used to step down the bulk supply from 11,000 V. Just before the war the old 2,000-V system was being changed over, but a considerable proportion still remains. The distribution voltage, originally 100 V, was changed to 200/210 V in 1900 and has since been gradually raised to 230 V. Between 1926 and 1928 the frequency was changed from 94 cycles to 50 cycles at a cost of £30,000.

The original area of supply covered 3·3 sq. miles, which has been extended by various Orders (the last in 1927) to 56·8 sq. miles. In the early years a deficit of £17,000 was accumulated, but this was not paid out of the rates. Under an Act of Parliament the Corporation was permitted to raise a loan for the purpose and the amount was therefore paid off by the consumers themselves. Now the undertaking's financial position is such that during the war years it has been able to reduce its general tariff three times. Total sales amount to about 38 million kWh (a little over 500 kWh per head of the population), having more than doubled in the last five years. Amicable relations are maintained with the local electrical contractors through the Cheltenham Electrical Development Circle conducted under the auspices of E.D.A. This Circle is one of the few organisations of its kind which have functioned normally throughout the war.

There have been only three engineers and managers of the undertaking. Mr. Hamilton Kilgour, the first, was succeeded in 1905 by Mr. W. J. Bache, M.I.E.E., who served until his retirement in 1942 and was president of the I.M.E.A. in 1938. The present engineer is Mr. R. W. Steel, A.M.I.E.E.

Manufacturers' War Work—III

Large-Scale Production of Parts

In this article details are given of the manufacture by electrical concerns of a wide range of parts of equipment needed by the Services.

Graham Farish, Ltd.

IN the very early stages of the war Graham Farish, Ltd., became entirely occupied with work of high priority for the Ministry of Supply, including small turned precision work, die-castings and bakelite mouldings,

Practice drift indicator, projection type (Graham Farish)

forming parts for guns, ammunition, anti-tank mines, etc. The manufacture of strip mattresses for the Ministry of Works was also undertaken. At one time the company actually turned out 3½ million parts per week for incendiary bullets from only two machines. In July, 1942, a congratulatory telegram was received from Viscount Gort of Malta.

While still maintaining some of the Ministry of Supply work, production was later changed over to equipment for the Ministry of Aircraft Production, including turned work for bomber parts. In addition the practice drift indicator for training pilots was entirely redesigned by Mr. T. Graham Farish and produced by the company. The prototype was made in only five weeks and the quantity produced in a short time enabled training command to overcome a very serious hold-up. As a development of this instrument, a projector instrument, which enables a class to be instructed instead of only one man, was later made. At the same time the company undertook a considerable amount of instrument work for the Admiralty, manufacturing among other things time-base units, emergency switches, thermo-couple units, and submarine aerials.

Hoover, Ltd.

As early as the autumn of 1938 the executives of Hoover, Ltd., decided that if and when war came the company must play its part, and accordingly an endeavour was made to obtain contracts. After small orders for cylinder studs and hot air blowers, the first real contract came from the Air Ministry for 20-W rotary transformers, 1,500 to be delivered within three months from receipt of drawings. The job was completed by the appointed date. From that time the story has been one of constant progress. The chief items produced have been: Small electric rotary transformers and motor generators for aircraft radio sets and aircraft signalling and for the radio equipment on armoured fighting vehicles (up till July, 1944, over half a million of these had been supplied); small electrical blowers for heating and cooling; fractional-HP motors; prefabricated electrical wiring sets for Halifax,

Assembling main control panels for the Lancaster at the Hoover works

Lancaster and Stirling bombers and the Meteor jet plane fighter; variable-pitch "Rotol" type propellers for Spitfires, Seafires and Barracudas; fuses for trench

mortar and aircraft cannon shells; oxygen equipment for airmen; 250/1,000-lb. bomb racks for the Halifax and Mosquito. In addition there were numerous contracts for various electrical equipment, mainly for aircraft. The company's development department also designed other equipment for mass production, including the "Lifebuoy" flame-thrower pistol, which it was not able to manufacture owing to other commitments.

Much of the machinery and machine tools used for producing vacuum cleaners was adapted for war production. For example, the die casting machines used for producing the castings of the cleaner helped to make 16,000,000 fuses in two years. By 1944 the company controlled thirteen factories in London, the Home Counties and in Scotland. Close working arrangements also existed with four more, where part-time labour was employed exclusively. The company claims to be among the pioneers of "Taking the work to the worker" scheme. Its first factory operating on such a basis was opened in July, 1942, in Gerrards Cross.

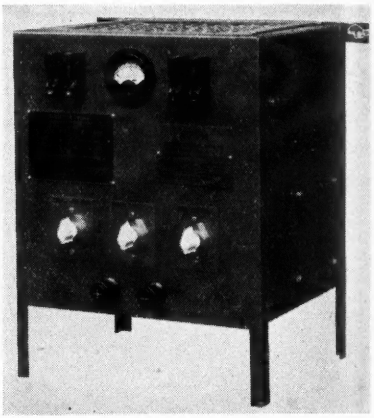
Westinghouse Brake & Signal Co., Ltd.

Metal rectifiers made by the Westinghouse Brake & Signal Co. have found their place in every theatre of war—on aerodromes, in every type of aircraft, in tanks, in signalling and telecommunication, as well as in every branch of war industry itself; and up to the beginning of 1945 the number of rectifier elements produced reached the remarkable figure of 115,000,000, while completed sets amounted to 76,500. In these sets were included transformers and chokes, also made in the same factory, to a total of over 120,000, in the manufacture of which was used 1,625 tons of electrical steel sheets for the various shapes and laminations, while the weight used of copper wire of various gauges and coverings was over 500 tons.

Metal rectifiers, however, form only one branch of the company's production. For instance, to the Admiralty went amongst other items 134 sets of searchlight control gear, 220 sets of gyro compass gear, 2,080 junction boxes and 156,000 cable glands for degaussing equipment on merchant ships, 6,200 contact stacks for anti-submarine apparatus, 300 sector lights for aircraft carriers, and 480 solenoids for fire control gear; to the Air Ministry 85,000 voltage regulators; and to the Ministry of Supply 5,700 3-in. magslip transmitters, etc.

Figures of production of non-electrical equipment were also impressive, with 31,800 mechanism plates, 37,800 soluble plug devices and 20,000 sets of parts for sinkers of mines, 7,000 gun sights of different types, and apparatus in large quantities for frigates, corvettes, mine sweepers and landing craft, and for depth charge equipment, etc., for the Admiralty. The Air Ministry received 2,966 live line pumps, 2,009 tailwheel shock absorbers for bombers, 2,955 undercarriage jacks for bombers, 5,100 fairing door jacks for fighters, and 1,100 bomb door jacks for bombers, with large quantities of various precision parts for Rolls-Royce "Merlin," "Vulture" and "Peregrine" engines.

For the Army the company made 1,021



More than 4,400 of these Westinghouse rectifier sets have been supplied to the Air Ministry

2-pdr. anti-tank gun carriages, 9,605 variflow pumps, 10,100 handles and valve boxes for tanks, 1,250,000 bodies and tails for anti-tank grenades, 85,000 3-in. mortar bomb cases, large numbers of parts for various types of guns, 14,137 air compressors, 7,138 combined reservoir and governor units, 4,310 charging valve units, 9,696 foot control valves and 3,028 boosters for brakes for 4-wheel-drive and heavy armoured vehicles, and 6,350 emergency relay valves for tank transporters. In addition, for railway service 493 air brake sets were made for ambulance trains, 1,240 sets of brake equipment for "austerity" locomotives, 4,500 vacuum brake sets for tank wagons, etc., besides railway signalling equipment of various types in large quantities.

Wingrove & Rogers, Ltd.

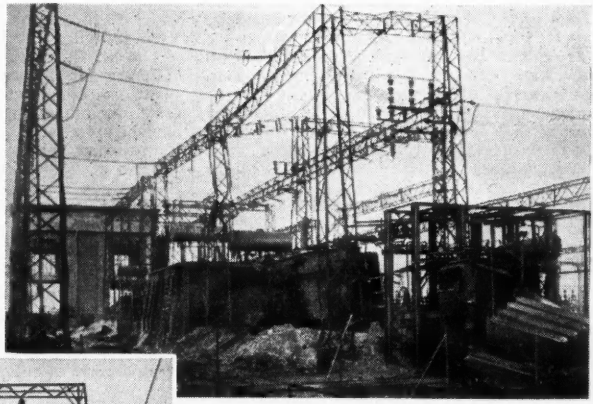
An extremely large proportion of the variable condensers used in the radio and radiolocation equipment of aircraft, ships, tanks, etc., has been made by Wingrove & Rogers, Ltd., who also since the beginning of the war have had to meet a five-fold increase in the demand for their industrial battery-driven electric trucks. Especially remarkable is the way in which the dock authorities have come to appreciate the time-saving qualities of the electric trucks. The company is now engaged on special problems relating to radio equipment for the war in the Far East.

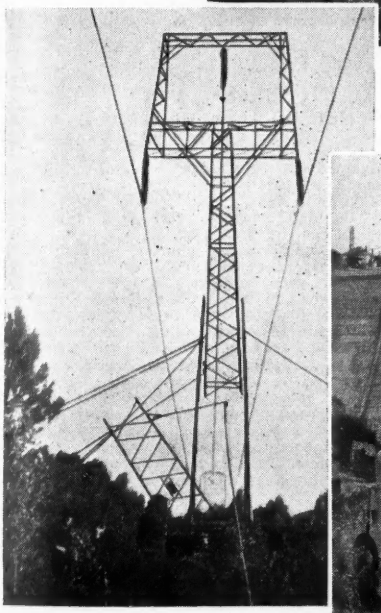
News from France

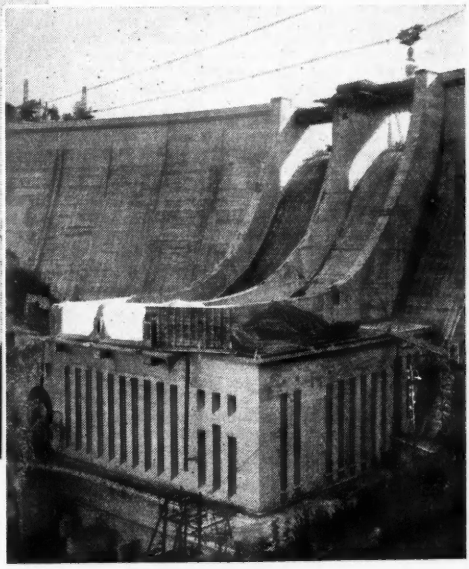
By Our Paris Correspondent

It is now revealed that France has a number of different plans for electrical construction and reconstruction. The "1938 Plan" included the Aigle and Genissiat plants, both of which are nearing completion although they have, of course, been held up by the war. There is also a "1941 Plan" which envisages barrages at St. Pierre-Champs on the Isere and others at Bort and Chastang, on the Dordogne.

Particularly interesting is the "1945 Plan" which would have been started had not the war retarded all the plans. This includes plants on the Rhone which will be as important as that at Genissiat. There is also a project for an extensive barrage across the Bay of Granville, which will use the tides for power production, and a figure of 60,000 million kWh a year has been mentioned. It is not expected that this project will reach







Top: Destruction by Germans at the Distré substation in August, 1944. Above: Replacing a tower on the 220-kV line between Chaingy and Eguzon. Right: The St. Etienne-Cantales plant

finality before 1965. The Bay of Granville is said to be the only one where the tides will permit the economic production of electricity.

Before the liberation of France the patriots selected transmission towers for attention because they could be easily cut and also because their cutting was not irreparably harmful to the country's electrical equipment. Now it has been necessary to patch up the damage in order to restore the electricity supply as quickly as possible. For example, wood crossbars are attached to towers where the metal bars have been damaged and trees have been used as a temporary expedient on a number of occasions.

French engineers are now in Germany taking over electrical production in those parts occupied by the French Army. It is expected that the engineers will run the plants with German labour and that at least part of Germany's electrical production will be imported by France to meet French demands.

During the occupation, in spite of the great raw material and labour shortages, the Energie Industrielle completed the barrage at St. Etienne-Cantales. This construction, which is part of the ten-year programme drawn up in 1938, is on the Cere river and is an exploitation of the Société Hydro-Electrique, which also constructed the barrages at Lamativie and Laval-en-Cere, which have an average output of 200 million kWh annually.

The St. Etienne barrage contains interior galleries for inspection. The generating plant is constructed of reinforced concrete, including the roof, as a precaution against air attack. It contains a 50-metre-long turbine gallery which will contain three groups of 25,000-kW generators. Two of the groups have been erected and one is working; the third is to be installed later.

Commissioners' Memoranda

Disposal of National Reserve of Equipment

IN view of the war situation the Central Electricity Board has decided that a considerable amount of the national stores of emergency equipment provided under Section 42 of the Civil Defence Act, 1939, can now be sold. The Electricity Commissioners, after consultations with the Ministry of Fuel and Power, have expressed their concurrence.

Requests are being received from liberated and other Allied countries for the sale to them of some of the equipment, but before coming to a decision on such requests the Commissioners desire to ascertain whether and to what extent authorised undertakings in this country wish to purchase any of the equipment to meet urgent requirements. The equipment was mostly purchased in 1939-1940, since which date prices have materially increased, and after consultation with the National A.R.P. Committee for the Electricity Supply Industry, and the Treasury, it has been decided that the price to be asked for each item should be the original cost plus 21 per cent. to cover accrued storage and other charges.

On sale, the equipment would be taken over by the purchaser at the storage depots, when any liability of the C.E.B. would cease, and the purchaser would have to arrange for any necessary packing and to defray the cost of transport from the Depot at which the equipment is available.

Any further detailed information (including prices) required about the equipment, can be obtained in writing from the Chief Engineer, Central Electricity Board, Horsley Towers, Easy Horsley, Surrey. If it is desired to inspect any of the equipment, arrangements should be made through the District Managers of the Central Electricity Board. Undertakings which are considering purchasing any of the equipment should inform the Commissioners not later than May 31st.

With regard to the Government's decision that the Civil Defence organisation is no longer needed, and that all A.R.P. measures can be discontinued, the Electricity Commissioners state that the fact that arrangements relating to these matters need no longer be continued for war purposes does not imply that there should be any abatement of measures relating to matters such as fire-prevention and first-aid in so far as they are essential or desirable in connection with the operation of the undertaking under normal peacetime conditions. Furthermore, on matters such as arrangements for mutual aid which may have a peacetime value, undertakings may wish to consider whether they could not be retained with advantage, though possibly on a modified basis.

Air-raid shelters provided for the protection of the staff, and structural or other measures taken for the protection of plant, etc., which seriously impede the efficient working of the undertaking, or which, if on the highway, interfere with the movement of traffic or pedestrians, may be removed as and when labour can be made available from within the undertaking's own resources, and subject to any necessary authorisations being obtained under Regulation 56A of the Defence (General) Regulations. No assistance by way of grant will be available in respect of expenditure incurred in the removal of the protective measures referred to.

The Commissioners take the opportunity to express their appreciation and thanks to the management, staff and workmen of all electricity undertakings for their outstanding efforts which enabled electricity supplies, so vital to the national war effort, to be successfully maintained, often under the most difficult operating conditions; for the effective arrangements for the prompt restoration of such supplies which were interrupted as a result of enemy action; and for their ready co-operation in carrying into effect the many controls and restrictions which have had to be imposed from time to time during the war. The electricity supply industry has a record of wartime achievement of which, say the Commissioners, it has every reason to be proud.

ELECTRICITY SUPPLY

Proposed Canterbury Area Extension. Eire Price Increase.

Aireborough (Yorkshire).—STREET LIGHTING.—The Council has decided to make a comparative test of the cost of electricity and gas for street lighting on two of its housing estates. For the lighting of the Springfield Farm estate the Electrical Distribution of Yorkshire, Ltd., has quoted £2 6s. 4d. per lamp, not to include maintenance. The quotation of the Guiseley Gas Company for the other estate is £3 12s. per lamp, to include maintenance.

Bolton.—POWER STATION EXTENSIONS.—The Corporation is to apply for consent to borrow £655,373 for extensions at the Back-o'-th'-Bank generating station (£513,150 for plant and £142,223 for buildings and civil engineering work).

Bradford.—POWER PLANT.—The Electricity Committee is seeking sanction to borrow £226,250 for the installation of a turbo-alternator, etc., at Valley Road power station.

Canterbury.—INCORPORATION OF HACKINGTON AREA PROPOSED.—At the May meeting of the City Council Councillor J. Symns moved that in view of the general desire of the consumers in the Hackington area to be transferred to the Corporation electricity undertaking, the Electricity Committee be requested to investigate the possibility of extending the area of the undertaking so as to be at least co-terminous with the city boundaries. Councillor Symns said that for seven or eight years they had had trouble. Hackington people paid Canterbury rates; why should they have to ring up Deal when trouble occurred? One day the previous week the electricity was cut off from 7 a.m. until noon.

The Mayor (Alderman C. Lefevre) reminded the Council that when they had the opportunity to take over the area, on the extension of their boundaries, they did not take it.

The resolution was carried by thirteen votes to three.

Hazel Grove and Bramhall.—REMOTE CONTROL RELAYS.—The U.D.C. is applying for sanction to borrow £5,215 for the purchase of relays for remote control equipment for water heaters.

Liverpool.—SUPPLY TO L.M.S. RAILWAY.—The Electric Power and Lighting Committee is making application to the Electricity Commissioners to borrow a sum not exceeding £33,000 in connection with the provision of a supply of electricity to the L.M.S. Railway for the Liverpool-Southport electric line.

Scotland.—HYDRO-ELECTRIC DEVELOPMENT.—Referring to the short note in our issue of May 4th Mr. Allan Arthur writes to say that it was moderate schemes of a few hundred kilowatts and not small schemes which he suggested could best be constructed by the North of Scotland Hydro-Electric Board. The relevant quotation in full is as follows:—"It probably would have been better had the Board proceeded with more moderate schemes which would operate on the difference between the winter and summer levels of the lochs involved. There is no doubt that moderate schemes, which are much more suited in every way to our scenic and climatic conditions, can be made to pay, as many small projects of under 50 kilowatts are operating economically to-day in Highland glens at well under ½d. per unit. These schemes [that is, the moderate schemes not the small schemes], which could supply all the needs of the Highlands . . "

Sheffield. — MAINS AND EQUIPMENT. — Application is being made by the Electricity Committee for sanction to borrow £25,000 for mains for temporary houses and £25,000 for meters and transformers.

Wallasey.—WATERWORKS PLANT.—The Water Committee is to modernise the pumping system at the Seaview Road waterworks, either by Diesel oil, coal gas or electrical machinery at an estimated cost of £11,000, and extend water-softening plant at a cost of £10,000.

Overseas

Eire.—ELECTRICITY TO BE DEARER.—The Electricity Supply Board announced on May 3rd, a "third emergency increase" in its charges, which will come into operation in the June-July accounting period. For domestic consumers on the two-part tariff the fixed charge remains unchanged but for electricity consumed the existing 20 per cent. addition is doubled. For public lighting supplies the emergency increase is raised from 10 to 30 per cent. and for slot meter, current limiter, coin limiter and unmetered supplies, from 10 to 20 per cent. For all other supplies the addition is 40 per cent. in lieu of the existing 20 per cent.

ERNE SCHEME.—An Order authorising the Board to proceed with the hydro-electric works on the River Erne has been made by Mr. Sean Lemass, Minister for Industry and Commerce.

Spain.—POWER PLANS INADEQUATE.—In a recent issue of *Metalurgia y Electricidad*, Señor Antonio Robert discusses the question of the increase in the demand for electric power in Spain during the next five years. At the end of 1943 the combined capacity of the generating plants amounted to 1,585,000 kW. Although new stations and plants are being constructed, with a total capacity of 553,445 kW, the author fears that in 1950 there will be an even greater shortage than at present, for if the extensions at present in hand can be all completed by that time the aggregate generating capacity will be only 2,138,000 kW, as against an anticipated demand equal to 2,950,000 kW.

RADIO and TELEPHONY

Great Britain.—RADIO LICENCES.—There are now the record number of 9,710,850 radio receiving licences in force in Great Britain and Northern Ireland.

RELAY STATISTICS.—At December 31st, 1944, there were 551,703 subscribers to 274 radio relay exchanges, compared with 527,688 subscribers at September 30th, an increase of 24,015.

Spain.—NATIONALISATION OF TELEPHONES.—The Spanish Government has acquired the bulk of the shares in the Spanish Telephone Co., held by the International Telephone and Telegraph Corporation of New York.—*Reuter.*

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Johnson & Phillips, Ltd.—Speaking at the annual general meeting on May 10th, Mr. G. Leslie Wates, chairman and managing director, said that the intention in general terms of the Government to take over in some form or another the electricity distribution undertakings of the country had been confirmed on more than one occasion recently, although he surmised that it was unlikely that any precise scheme would be formulated until after the General Election. Whatever scheme might be produced he did not think shareholders need have any anxiety as to the financial results of the company.

Since the close of the financial year the company had purchased the whole of the capital of Aurora Lamps, Ltd. They had continued to devote a great deal of attention to their organisation overseas and at the beginning of this year had purchased the manufacturing business of Godfrey (Pty.), Ltd., in Australia, it being proposed to make in Australia certain of the smaller units of switchgear which they exported from England until the protection of local industry rendered this impossible. In India local manufacture and imports were by no means mutually exclusive and they were making plans to share in both.

On the subject of cartels Mr. Wates said he held firmly to the view that the activities of the Cable Makers' Association were in the ultimate interest of customers, labour and shareholders. The C.M.A. was representative of the most important firms in the industry but was in no sense a monopoly; in fact, numerically there were more cable-making firms outside than inside the Association. Similar reasoning applied to the British Electrical and Allied Manufacturers' Association of which they were also members.

The Rheostatic Co., Ltd., reports a trading profit of £38,956 for the year ended September 30th last as compared with £35,626 for the previous year. Income from other sources brings the total to £38,966 (£35,701). After allowing for directors' fees £250 (same), depreciation £9,030 (£8,180), income tax and E.P.T. £19,956 (£18,487), there is a net profit of £9,730 (£8,784). A final ordinary dividend of 8 per cent. makes a total distribution of 12 per cent. (same). General reserve receives £4,000 (£3,000) and £4,170 (£4,140) is carried forward.

Newman Industries, Ltd., report an increase in the net profit from £70,978 for 1943 to £82,652 last year. Tax provision amounts to £52,250 (£41,000). It is proposed to pay a final ordinary dividend of 12½ per cent. plus a bonus of 2½ per cent., making the total distribution for the year 22½ per cent. (against 20 per cent.), and £20,366 (£18,014) is carried forward.

The British Electric Traction Co., Ltd., records a revenue for the year ended March 31st last amounting to £779,608, compared with £767,962 for 1943-44. After deducting the general expenses, etc., and debenture stock interest, and providing £317,791 for income tax (£312,677), there remains £323,737 (£316,441). The directors recommend the payment of the following final dividends:—5 per cent. on the participating preference stock, making 8 per cent. for the year (same); 4 per cent. on the preferred ordinary stock, making 8 per cent. (same); and 30 per cent. on the deferred ordinary stock, making 45 per cent. (same). This leaves £62,110 to be transferred to undivided profits account.

Laurence, Scott & Electromotors, Ltd., report a trading profit for 1944 (after providing for E.P.T.) of £139,311, compared with £142,362 in 1943, and a net profit of £110,032 (£109,504). Preference capital redemption reserve receives £6,600 (£6,688), income tax for 1945-6, £56,000 (£54,000), pension fund £5,000 (same), staff deferred annuity scheme £2,500 (same) and reserve fund £10,600 (same). The ordinary dividend is maintained at 12½ per cent., and £7,029 (£6,871) is carried forward.

The Ever Ready Co. (Gt. Britain), Ltd., announces that after meeting E.P.T. the profit for 1944-45 was £747,745, against £820,376, and the net profit £588,935 (£621,813). The allocations include £145,800 (against £178,247) to reserve and the ordinary dividend is maintained at 40 per cent. by a final payment of 25 per cent. The decrease in profit is attributable to the reduction of the E.P.T. capital structure due to the writing off in the plant, etc., account. It is stated that it will now be possible to increase and improve the supply to the home market.

Richard Johnson & Nephew, Ltd., record a profit after taxation amounting to £45,860 for the year to March 31st last. This compares with £43,773 in the previous year. After providing for directors' fees £1,062 (£1,250), preference dividends £10,500 (same), pensions £7,500 (same), and general reserve £10,000 (same), the ordinary dividend is maintained at 9 per cent. and £42,505 (£39,207) is carried forward.

Jenson & Nicholson, Ltd., announce a net trading profit for 1944, after providing for E.P.T. but subject to income tax, amounting to £86,222 as compared with £86,717 in 1943. After providing for preference dividends and carrying £8,707 to reserves, an ordinary dividend of 25 per cent. (same) is recommended, leaving £7,907 (£7,264) to be carried forward.

Hopkinsons, Ltd., are raising their final ordinary dividend from 12½ to 15 per cent., making 20 per cent. (against 17½ per cent.) for the year. The net profit rose from £74,043 to £89,498.

The Ascot District Gas & Electricity Co., Ltd., is paying a final dividend of 3½ per cent., making 6 per cent. (same).

The Associated Equipment Co., Ltd., is to pay an interim dividend of 6d. per £1 unit of stock, tax free (same).

Radio Rentals, Ltd., is maintaining its interim dividend at 5 per cent.

The Ever Ready Co. (Ireland), Ltd., is to pay a final dividend of 10 per cent.

New Companies

Super Tension Cables, Ltd.—Private company. Registered in Edinburgh, April 28th. Capital, £500. Objects: To manufacture, buy, sell, deal in and import and export cables, wires and metals of every kind, etc. Subscribers: J. Law, 83, Brisbane Road, Largs, Ayrshire, and J. Frame, 123, Hope Street, Glasgow. Registered office: 123, Hope Street, Glasgow.

Frith Radiocraft, Ltd.—Private company. Registered May 2nd. Capital, £1,000. Objects: To carry on the business of manufacturers of, and dealers in, wireless sets, electrical apparatus, etc. First directors: H. W. Frith, 21, Overdale Road, and A. C. Frith, 3, Cameron Avenue, both Leicester. Registered office: 69, Church Gate, Leicester.

Hurst Electrical Industries, Ltd.—Private company. Registered May 2nd. Capital, £2,000. Objects: To carry on the business of electrical engineers and contractors, electricians, wireless dealers, etc. Directors: W. A. Smith, 16, Laurel Terrace, Park Lane, N.17, and B. R. Turner, County End, Spriggs Holly, Chinnor, Oxon (director of Turner Components Engineering Co., Ltd.). Registered office: Havelock Works, 75a, Well Street, Hackney, E.9.

Moseley Brothers (Acton), Ltd.—Private company. Registered May 3rd. Capital, £600. Objects: To carry on the business of electrical wiring installations, and maintenance engineers, manufacturers, distributors and repairers of electrical equipment and household appliances. First directors: F. J. Moseley, 16, Newton Avenue, W.3, F. C. Moseley, 33, Percy Road, Isleworth, and Vera G. Harding, 210, Southfield Road, W.3. Registered office: 16, Newton Avenue, W.3.

Electrical & Radio Installations (Ealing), Ltd.—Private company. Registered May 4th. Capital, £3,000. Objects: To carry on the business of electrical and radio engineers, etc. First directors: C. J. C. Berkley, 4, Ealing Court Mansions, Ealing, W.5, and E. Jeffryes, 25, St. James Avenue, W.13. Registered office: 11, Ealing Court Mansions, Ealing, W.5.

A. W. Gordon, Ltd.—Private company. Registered in Belfast April 17th. Capital, £10,000. Objects: To carry on the business of importers and exporters of, agents for and wholesale and retail dealers in wireless, electrical and mechanical apparatus and appliances of all kinds, etc. A. W. Gordon, 15, Kilhorne Gardens, Belfast, is the first director. Registered office: 61, Scottish Provident Buildings, 7, Donegall Square West, Belfast.

J. C. Williams (Contractors), Ltd.—Private company. Registered April 25th. Capital, £500. Objects: To carry on the business of electrical, mechanical and general engineers, etc. First directors: J. C. W. Williams, 229, Cannon Hill Lane, London, S.W.20, and three others. Registered office: 229, Cannon Hill Lane, S.W.20.

Companies to be Struck off the Register

The following companies will be struck off the Register at the expiration of three months from May 4th, unless cause is shown to the contrary: The Craven Radio & Service Co., Ltd.; and Electric Agencies, Ltd.

Companies' Returns

Statements of Capital

W. H. A. Robertson & Co., Ltd.—Capital, £36,000 in 600 ordinary and 3,000 preference shares of £10. Return dated September 29th. 600 ordinary and 2,180 preference shares taken up. £25,650 paid (£10 on 600 ordinary and 1,750 preference and £5 on 430 preference). Mortgages and charges: Nil.

Stella Conduit Co., Ltd.—Capital, £20,000 in £1 shares. Return dated December 5th. All shares taken up. £20,000 considered as paid. Mortgages and charges: Nil.

Bushing Co., Ltd.—Capital, £100,000 in £1 shares. Return dated December 13th. 80,000 shares taken up. £80,000 paid. Mortgages and charges: Nil.

Reliance Electrical Co., Ltd.—Capital, £500 in £1 shares. Return dated December 12th. 300 shares taken up. £300 paid. Mortgages and charges: Nil.

Mortgages and Charges

De Renzi, Holmes & Co., Ltd.—Mortgage and charge on freehold land and factory in Fox's Lane, Wolverhampton, with plant and machinery, and the company's undertaking and other property, present and future, including uncalled capital, dated April 4th, to secure all moneys due or to become due from the company to Midland Bank, Ltd.

English Electric Co., Ltd.—Satisfaction to the extent of £26,727 on November 15th, 1924, of 4 per cent. debenture stock secured by trust deed dated May 7th, 1936, and registered May 12th, 1936. (Notice filed April 21st, 1945).

Page & Miles, Ltd.—Mortgage on 60, Western Road and 43, Castle Street, Brighton, dated April 6th, to secure £8,000; also mortgage on same properties, dated April 7th, to secure £2,500. Holders: Mrs. N. E. Burgoyne, Haywards Heath, and another.

H. Garstang, Ltd.—First mortgage debenture, charged on the company's undertaking and property, present and future, including uncalled capital, dated April 23rd, to secure all moneys due or to become due from the company to Martins Bank, Ltd.

Electrical & Radiological Instrument Co., Ltd.—Mortgage on part of Brent Field, Killigarth, Lansallos, Cornwall, dated April 7th, to secure £500. Holder: A. Lightfoot, Lansallos.

Winding-up Petition Dismissed

B. & B. Batteries, Ltd.—Before Mr. Justice Cohen, sitting in the Companies Court of the High Court last week, a petition for the compulsory winding up of the company was, by consent, dismissed.

Bankruptcies

T. Hughes-Davies, wireless engineer, Radio House, High Street, Bangor.—Supplemental dividend of 19s. 2d. in the £ payable May 9th at the Official Receiver's office, Hunter Street (Friends' Meeting House), Liverpool, 3. As debts have now been paid in full the receiving order dated May 9th, 1933, was annulled on March 19th.

STOCKS AND SHARES

TUESDAY EVENING.

THE end of the war in Europe last week had been previously discounted by Stock Exchange markets in a measure which left, for the time being, little further scope for improvement. To some extent, the announcement of the actual VE-Day came as anti-climax. It was immediately preceded by a fairly general fall in prices, due, more than anything else, to the rift in the lute at the San Francisco Conference, and to what looked like semi-official prophecies as to an early General Election. These two factors, taken together, induced caution both as regards investment and speculative investment, with a result that business, previously active in the Stock Exchange markets, tended to diminish. As is usual in such circumstances, prices eased off.

Jobbing Backwards

Looking back to the days shortly before the outbreak of war in Europe, the standard rate of income tax has risen from 5s. 6d. in the £ in April, 1939, to the present 10s. in the £, introduced two years later. Excess profits tax of 60 per cent. followed upon the declaration of war, to be raised to 100 per cent. in April, 1940. The National Debt, £8,163 millions in 1939, had swollen to £22,398 millions last month. Purchase tax came into being in July, 1940; its luxury rate was raised to 100 per cent. in April, 1943. From even these few figures there becomes vaguely apparent the colossal task imposed by the financing of the war. Roughly speaking, the cost of the war to date has been met by revenue and loans in the proportion of 50-50 per cent. The Government has kept tight control over the money market and this has much to do with the substantial rises in price shown by the shares of many industrial and other companies.

1939-1945

At the outbreak of hostilities in Europe, War Loan 3½ per cents. stood at 88½. To-day's price is 103¼. Gilt-edged securities advanced early in the war, thanks to the Government's financial policy, but industrials —and many others—were depressed and, on the collapse of France in 1940, heavy falls occurred. The prices of those unhappy days were in most cases the lowest touched during the war period. Then, as money began to accumulate, and many large repayments of their loans were made by Colonial and other borrowers, industrials came once more into favour. People began to discuss post-war prospects as the assurance of final victory grew clearer. A general upswing of prices set in. After five and a half years of war, industrial quotations are substantially up as compared with those of early September, 1939. Taking a few at random, the following give a good idea of what has happened in various sections:—

Ordinary	Sept. 7th 1939	May 11th 1945	Rise
Aut. Telephone ..	43/6	70/–	26/6
Babcock & Wilcox ..	45/–	56/–	11/–
Brit. Insulated ..	83/–	123/9	40/9
Cable & Wireless ..	49	94	45
Callender's	61/–	126/3	65/3
Cole, E. K.	4/–	41/3	37/3
Crompton Parkinson	18/3	34/–	15/9
Edmundsons	21/6	32/–	10/6
Ericsson Tel.	41/3	56/–	14/9
Enfield Cable	48/9	68/–	19/3
Elec. & Musical ..	9/3	34/9	25/6
Ever Ready	20/6	44/6	24/–
General Electric ..	74/3	96/6	22/3
Henley's	18/–	29/9	11/9
H.T.A.	19/–	32/–	13/–
Johnson & Phillips ..	38/–	76/–	38/–
Laurence Scott ..	9/6	14/–	4/6
Lond. Elec. Wire ..	28/6	39/–	10/6
Murex	3⅞	4⅞	20/–
Siemens	21/–	37/–	16/–
Tel. Construction ..	38/–	62/6	24/6
West (Allen)	6/–	8/9	2/9

This Week's Changes

With two business days taken out of last week for victory celebrations, prices could hardly be expected to show striking changes. The general tendency was dullish, for the political reasons, foreign and domestic. A drop of 10s. lowered De la Rue shares to 10¾, which compares with 11 $\frac{9}{16}$ a few weeks ago. Murex at 4⅞ and Automatic Telephones at 70s. went back 2s. 6d. each. These last two falls are ascribed to profit-taking by previous buyers who had got in more cheaply. It is equally possible that last week's sellers may have included some who had no profit to take. International Combustion are down ⅛ at 7¾. Electric & Musical (10s.) shares at 34s. 9d. are 6d. lower, A. C. Cossor (5s.) shares at 33s. 6d. being better by the same amount. Vactrics eased off to 23s. 6d.

Bright Spots

British Vacuum Cleaner are nearly a florin higher at 34s. 9d. ex dividend. British Insulated at 6 $\frac{3}{16}$ and Callender's at 6 $\frac{5}{16}$ hold their gains, and Henley's are a trifle harder at 29s. 9d., equal, of course, to 119s. for a £1 share. General Electric 6½ per cent. preference at 35s. are 6d. better. Great Northern Telegraphs rose £2 as a result of the liberation of Denmark. The dollar stocks responded with improvements to the victory news. International "Tel. & Tel." went up 2 to 36, Brazilian Tractions ⅜ to 27⅜ and Canadian Marconi 6d. to 13s. 6d. The only changes amongst home electricity supply shares is a gain of 6d. in City Lights to 22s. 6d. and a similar decline, to 44s. 6d., in Metropolitans. The Indian group is quiet; Madras Electrics are better at 35s. and Calcutta Trams 1s. lower at 63s. 6d.

Export Delivery Details

How To Avoid Irritation and Delay

By F. G. Copland, B.Eng., A.M.I.E.E.

THE imminent prospect of a return to peacetime activities prompts the following notes for the consideration of those of our exporting manufacturers to whom they are applicable. The points raised are based on the thesis that a not inconsiderable portion of the engineering export business consists of small repetition orders and that the placing of these is influenced, not by weighty conferences of senior officials, but by an abstraction which for lack of closer definition may be called reputation. I believe that this reputation arises from the pooled opinions of junior members of the purchaser's staff, and that these opinions are influenced by individually unimportant, but collectively decisive, details which are far too often overlooked by manufacturers.

Modern competition has ensured that there is little difference in the quality and performance of the products of leading engineering firms, and chief engineers will incline away from those firms whose reputation is bad with the men on whom they rely to install and operate new gear. In chronological order, these men are the storekeeper, the erector, the operator and the engineering office staff. Quite small details can cause the difference between a rapidly installed and comfortably forgotten job, and one which drags on until all concerned are heartily sick of the product and its producer. Here are a few of those details.

Points about Packing

The storekeeper asks for a stout case which will arrive unbroken, bearing numbers which agree with the shipping papers and are easily visible in the harsh shadows cast by tropical sunlight. And if these numbers are marked on more than one face he may be saved hours of searching in a crowded, sticky unloading bay. Similar numbers are often used by different suppliers, and a clear indication of the contents and/or the supplier's name will prevent exasperating confusion.

When the erector takes over he hopes, often too optimistically, to find the interior packing suited to the contents. Wood wool and shavings are useless for ferrous materials in the tropics; electrical parts *must* be thoroughly sealed and if parts have to be detached for transit they must be clearly identifiable—and complete. Two copies of any drawing necessary to assembly will relieve the erector of the annoying need to keep an only copy clean so that it can be returned to " the office " for record purposes. General arrangement drawings sometimes assume a degree of familiarity with the subject not possessed by the erector, who hates to call on his superior unless he is completely fogged, tempting him to make guesses which may have expensive consequences. In short, assembly and erection instructions cannot be made too simple.

Constructional irritations to be avoided include the use of bastard size components unless suitable tools are provided, the omission of adequate lifting and handling lugs, and projecting thin castings which will be broken off as soon as native labour lays hands on the job. Working tolerances should be clearly indicated; access to site may involve, with often primitive handling gear, a complete stripping and reassembly of new plant. This can be vexatious enough alone, but the absence of information vital to reassembly can hold up the completion of work for weeks. The supplier cannot be blamed, but if he has in some measure provided for such a contingency he will earn valuable goodwill.

Operational Snags

Difficulties in erection and commissioning can at last be forgotten but operational snags are an ever-present nuisance. Personnel overseas changes far more rapidly than is the case in Britain and supervisory staff can become very tired of initiating new operators into the mysteries and peculiarities of machines. Stopping, starting, lubricating, etc., instructions, clearly printed on a durable mounting will prevent this irksome necessity. Simplified lubrication and minimum necessary maintenance, robust detail work such as piping clips, grease nipples, part labels, etc., which will not rust away in a few months—these and similar factors will ensure that the next machine will be obtained from the same makers.

Machines supplied for use in very inaccessible regions should be provided (at extra charge, of course) with those spares which the manufacturer's experience tells him will first be required. No gear is expected to last for ever and the suggestion that such spares be included in an order implies no criticism of the product and constitutes that form of sales service which is most likely to lead to repetitive business. The ordering of other spares should be made as simple as possible and, in particular, the use of common sizes of ball and roller bearings induces a favourable opinion in the engineer who has to carry stocks of bearings for normal maintenance.

A final point, one vital to operators using native labour, is theft prevention. The covers of lubrication oil wells, tool boxes, etc., should be provided with stout locks, most particularly in these days of acute shortage and astronomic prices, conditions which will endure for some considerable time in many places.

The chief engineer is concerned with all the foregoing details. In addition there are several which affect him alone. Adequate notice of the arrival of new gear, with dimensional data, enables him to allocate staff and time for its commissioning, clear sites and prepare foundations, and generally fit the work into a programme normally crowded and, in these days of labour shortage, often chaotic. He will be glad to receive a catalogue of any manufacturer's products—if it is not printed on glazed pages which stick together and become useless after a few months in a tropical climate. Far better to send him very full details of a new job when, or before, he receives it than a large decorative calendar at the New Year.

These are small details, obviously desirable when mentioned but far too often forgotten by British manufacturers whose foreign and colonial sales staffs seem to need the guidance of men who have had to commission incomplete gear damaged in transit, with inadequate tools and information, at the height of a monsoon, a West African rainy season or in frozen tundra.

Iranian Imports

Chief Gains by United States and Switzerland

THE accompanying statement gives the values in thousands of rials (rial equals about 3½d.) of the chief imports of electrical goods into Iran (Persia) in 1943–44, with a note of increase or decrease on 1942–43 where comparative figures are available. The outstanding increase was in radio receivers, in which Switzerland shared largely, while the only advance made by Great Britain which is worth mentioning took place in the cable trade. Business in both lamps and telegraph material made a big recovery, imports of these having trebled at least. Another noteworthy increase was in meters. On the other hand power plant and accumulators have been declining. Among supplying countries the appearance of India is noteworthy, as also is that of Russia in the radio trade. Germany and Japan still found some business.

For the import of practically all products into Iran licences have to be obtained from the Foreign Trade Control Division, Teheran, which works with the Middle East Supply Centre, Cairo.

Class of Goods and Country of Origin	1943-44 Rials (000)	Inc. or dec. on 1942-43
Motors, dynamos, convertors, etc.	224	− 244
From Germany	28	− 12
„ Great Britain	124	+ 4
„ United States	23	+ 23
„ British India	49	+ 32
Electric lamps—	3,481	+ 2,241
From Soviet Russia	52	− 658
„ United States	1,349	+ 1,324
„ Great Britain	1,670	− 1,310
„ British India	370	+ 370
Electrical apparatus for signalling, lighting, starting, etc., vehicles—	29	− 580
From Germany	10	+ 3
„ United States	18	− 324
Fans for houses—	226	+ 219
From Germany	100	+ 94
„ Great Britain	37	+ 37
„ British India	12	+ 12
„ Iraq	77	+ 77
Electricity meters—	1,813	+ 1,353
From Switzerland	1,697	+ 1,677
„ Great Britain	34	− 323
„ Japan	14	+ 14
Radio receivers and radiograms—	10,044	+ 7,464
From United States	1,328	+ 448
„ Iraq	1,749	+ 1,475
„ Switzerland	4,498	+ 4,392
„ Soviet Russia	1,143	+ 425
Radio valves	131	− 14
From Great Britain	21	− 16
„ United States	49	− 21
„ Switzerland	42	+ 42
„ Soviet Russia	8	− 3
Other parts for radio—	134	− 32
From Switzerland	127	+ 127
„ United States	3	− 27
Telephone material—	333	*
Telegraph material—	1,107	+ 829
From United States	1,043	+ 1,043
„ Great Britain	64	− 213
Accumulators and parts—	139	− 889
From United States	134	− 506
„ British India	4	− 278
Dry batteries—	200	+ 188
From Germany	9	+ 9
„ United States	121	+ 114
„ Great Britain	60	*
„ British India	10	+ 5
Ammeters, voltmeters, etc.—	207	+ 172
From Switzerland	99	*
„ Great Britain	25	+ 16
Insulated wire and cable, lead-covered or armoured—	27	+ 27
From Germany	15	+ 15
Ditto with rubber or similar insulation—	739	+ 24
From Great Britain	706	+ 150
„ British India	15	− 134
Ditto with silk insulation (from British India)	2	+ 1
Ditto, other—	3,319	+ 1,584
From United States	1,891	+ 1,340
„ Great Britain	1,055	+ 74
„ Japan	22	− 208
Insulating tubes—	94	+ 6
From Germany	13	− 39
„ Great Britain	80	+ 44
Unspecified electrical material—	378	− 96
From Germany	74	− 213
„ Great Britain	176	+ 41
„ Soviet Russia	2	+ 1
Electro-mechanical apparatus not over 15 kg., such as vacuum cleaners, polishers, coffee grinders	6	—

* Comparative figures not available.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specifications (1*s. each*) *may be obtained from the Patent Office*, 25, *Southampton Buildings, London, W.C.*2.

ALLDAY & SON (1922), Ltd., and R. Bain.—" Electric tumbler switches." 19721. November 25th, 1943. (568972.)

Babcock & Wilcox, Ltd.—" Steam generating installations." 9656/43. July 4th, 1942. (568924.)

British Electric Transformer Co., Ltd., and A. C. Whish.—" Temperature alarm devices." 12834. August 9th, 1943. (568934.)

British Thomson-Houston Co., Ltd. (General Electric Co.).—" Electric circuit controllers." 20234. December 3rd, 1943. (568984.)

A. C. Cossor and A. T. F. Reeves.—" Cutting devices for electric cable sheathing and the like." 17234. October 20th, 1943. (568907.)

Crompton Parkinson, Ltd., and A. W. Angold.—" Prepayment mechanism for meters and the like." 12147. July 26th, 1943. (Addition to 515223.) (569001.)

D. R. Davies and Metropolitan-Vickers Electrical Co., Ltd.—" Gas-blast electric switches or circuit-breakers." 18429. November 5th, 1943. (568967.)

H. Fitzpatrick and A. A. Fitzpatrick.—" Dynamos." 17508. October 25th, 1943. (568942.)

F. R. Ford.—" Morse or other code operated printers, or teleprinters." 17148. October 19th, 1943. (568938.)

General Electric Co., Ltd., E. Harvey and T. J. Curtis.—" Vacuum cleaners." 15537. September 22nd, 1943. (568958.)

E. E. Griffiths and J. E. Griffiths.—" Thermostatic means for regulating the heat supply to liquid-heating apparatus." 15443. September 21st, 1943. (Addition to 555298.) (568957.)

Hanovia, Ltd., and J. W. Kolbert.—" High-pressure mercury vapour discharge tubes." 15918. September 28th, 1943. (568960.)

N. L. S. Hay.—" Method of and means for electrodeposition of chromium." Cognate applications 18936/43 and 19962/43. November 13th, 1943. (568,869.)

Heating Construction, Ltd., and H. G. Darby.—" Hot-plates for domestic cooking apparatus." 17718. October 27th, 1943. (568865.)

G. R. Hook and Westool, Ltd.—" Electromagnets." 18544. November 8th, 1943. (568867.)

Insulation Equipments, Ltd., and A. G. Snell.—" Mounting of panels and the like." 2861/43. February 21st, 1944. (568852.)

Johnson & Phillips, Ltd. and C. J. H. Stevens.—" Electrical plug connectors." 5101. March 30th, 1943. (568916.)

J. McDonald and G. W. B. Electric Furnaces, Ltd.—" Furnaces with circulation of internal atmosphere." 16638. October 11th, 1943. (568980.)

Marconi Wireless Telegraph Co., Ltd.—" Cathodes for electron-discharge devices." 16362/43. October 6th, 1942. (568962.)

" Viewing devices." 17319/43. July 9th, 1942. (568982.)

F. Miller.—" Electric iron automatic temperature control, or the like." 16345. October 6th, 1943. (568961.)

H. Miller & Co., Ltd., and W. R. Smith.—" Electric generators." 17403. October 22nd, 1943. (568864.)

P. A. H. Mossay.—" Variable choke coils." 18772. November 11th, 1943. (568868.)

Pressed Steel Co., Ltd., and E. G. Rowledge.—"Method of lubricating refrigerator motor-compressors." 2143. February 5th, 1944. (568991.)

D. R. Price and Metropolitan-Vickers Electrical Co., Ltd.—" Electrical remote-control systems." 14472. September 4th, 1943. (568952.)

Scophony, Ltd., A. E. Adams, H. W. Lee, P. L. F. Jones and G. Wilkenhauser.—" Optical apparatus." 16995. October 15th, 1943. (568981.)

A. C. Scott & Co., Ltd., and G. W. Ashton.—" Wire-drawing machines." 21128/9. December 16th, 1943. (568878/9.)

M. L. Telcs.—" Sound-operated electric gear." 17741. December 14th, 1942. (568887.) Ditto, 20321/44. (Divided out of 568887.) (568912.)

Telephone Mfg. Co., Ltd., S. J. Smith and R. St. G. Terry.—" Apparatus for indicating the end of a predetermined time period." 21606/44. December 30th, 1943. (Divided out of 566345.) (568975.)

E. J. W. Watkinson.—" Grids for reducing secondary X-rays." 13625. August 20th, 1943. (568908.)

Zenith Radio Cpn.—" Radio receivers." 4406/43. January 16th, 1942. (568915.) Ditto, 20537/44. (Divided out of 568915.) (568944.)

U.S. and Russian Reconstruction

FAR-REACHING plans for the use of American goods, credit and services for the post-war reconstruction and development of the Soviet Union were disclosed at a meeting of American business men and Soviet representatives in New York.

Mr. E. C. Ropes, head of the Russian section of the Department of Commerce, told the gathering that Congress would probably soon approve a plan to open large credits to Russia in the form of long-term loans to help finance purchases in the United States. M. Gusev, head of the Amtorg Trading Corporation, said that purchases would include a vast series of plants for the manufacture of building materials and equipment for making prefabricated houses and parts. He added that building and construction offered one of the brightest and biggest fields for trade with America and disclosed that large post-war contracts had already been signed with the General Electric Company and others " only awaiting the establishment of terms of payment."—*Reuter.*

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Adwick-le-Street. — May 19th. U.D.C. Electricity Department. E.h.v. steel-wire armoured and l.v. steel-tape armoured cables; 250-kVA indoor transformer; and substation distribution panel. (May 4th.)

Amble.—June 14th. Electricity Department. L.v. mains and distributors, feeder pillars and services. (See this issue.)

Australia. — PERTH. — June 21st. Government of Western Australia. Switchgear, motor-generator sets and batteries. (May 4th.)

Dunbar.—June 9th. Town Council. Supply and installation of street lighting equipment including poles, lanterns, wiring and control gear. Specs. from burgh surveyor.

Manchester.—June 5th. Electricity Committee. Low-pressure pipework, etc., at the Stuart Street generating station. 10,000-kVA transformer, Denton (West) substation. (See this issue.)

Salford.—May 26th. Electricity Department. Steel street lighting standards. (May 4th.)

Orders Placed

Bradford.—Electricity Committee. Accepted. 22,500-kW turbo-alternator and modifications to associated condenser plant, etc.—C. A. Parsons & Co.

500 temperature compensated, single-phase house service meters (25-A).—English Electric Co. 500 ditto.—Sangamo Weston. 100 unbalanced load, 3-phase house service meters (25-A).—Chamberlain & Hookham. 100 ditto (10-A).—Ferranti.

Glasgow.—Corporation Lighting Committee. Accepted. Annual stores; Electrical fittings and accessories.—Holland House Electrical Co.; Wm. Geipel; British Electrical & Manufacturing Co.; Wm. McGeoch & Co.

Liverpool. — Electric Supply Department. Accepted, subject to sanction. Apparatus in connection with extension of the distribution system:—Two 15,000-kVA transformers (£21,760).—Metropolitan-Vickers. Four 33-kV oil-filled reactors (£6,280).—English Electric Co. Recommended. Additional protective gear at the Clarence Dock power station: Busbar protective equipment for main 33-kV volt switchboard (£6,215), multicore cables (£6,200), modifications to existing neutral switchgear and new cell work (£4,973) and three main neutral earthing resistors (£3,690).—B.T.H. Co. Three alternator neutral reactors (£1,059) and three alternator drain resistors (£640).—Metropolitan-Vickers.

London.—BATTERSEA.—Electricity Committee. Accepted. Telpher plant (£2,530).—Mitchell Engineering.

Swindon.—Electricity Committee. Accepted. 500-kVA transformer (£365).—Bryce Electric Construction Co.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Birkenhead.—Timber works for Marchbanks & Co., Ltd.; R. Owens & Son, architects, 11, Westminster Chambers, Liverpool, 1.

Blackpool.—Works additions and canteen, Vicarage Lane; Wm. Eaves & Co.

Bootle.—Works extensions; Johnson Bros. (Dyers), Ltd., Bootle Dyeworks, Liverpool, 20.

Cheltenham.—Houses (100), Winchcombe; R.D.C. surveyor.

Cheshire.—Extensions, Clatterbridge (£7,500) and West Park Institutions (£4,500); county architect, Chester.

Chesterfield.—Extensions to works; Sheepbridge Coal & Iron Co., Ltd.

Buildings (£600,000), Ashgate Road, for Chesterfield Hospital Board; M. H. Boone, superintendent-secretary.

Derby.—Radio-therapy centre, Derby Royal Infirmary; clerk.

Henley.—Maternity block, Henley and District War Memorial Hospital; clerk.

Kent.—County horticultural institute, Swanley; county architect, Maidstone.

Lancashire.—Junior and infants' school, Huyton; A. T. Nicholson, county architect, County Offices, Fishergate Hill, Preston.

Manchester.—Works extensions for T. C. Thompson & Son; B. Pendleton, architect, 16, Brazennose Street, Albert Square, Manchester, 2.

Additions to works for E. Raffles & Co., Ltd.; Moston Brick and Building Co., Ltd., Kenyon Lane, Manchester, 10.

Extensions to laundry; W. Watkins & Son, Whitworth Park Laundry, 150, Lloyd Street, Moss Side, Manchester, 14.

Newcastle-on-Tyne. — Factory; Northern Coachbuilders, Ltd., Claremont Road.

Nottinghamshire.—Farm institute, Ramsdale Park; county architect, Shire Hall, Nottingham.

Plaistow.—Completion of new wing at St. Mary's Hospital; clerk.

Portsmouth. — Additions (£24,790), Royal Portsmouth Hospital; secretary.

Rotherham.—Nurses' home, Doncaster Road; V. Turner, borough engineer, Town Hall.

Stratford (Essex).—Extensions, Queen Mary's Hospital; secretary.

Wembley.—Isolation hospital to be established (jointly with Harrow and Hendon authorities); C. S. Trapp, borough surveyor, Wembley Town Hall.

Workington.—Factory, Siddick Road; Cumberland Cloth Co., Ltd.

Worthing.—Enlargement of maternity home, Worthing Hospital (£10,000); Mayoress, Mrs. H. W. Shalders.